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VOLUME 1 NUMBER 24

N63-23001—N63-23821

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National Aeronautics and Space Administration
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Scientific and Technical Aerospace Reports, Volume 1, is prepared by the Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Documentation Incorporated.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget December 20, 1962

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Includes: aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc.

For related information see: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES 2029

Includes: ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics

04 AIRCRAFT 2030

Includes: specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; stability and control.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

05 ASTRONOMY AND ASTROPHYSICS 2032

Includes: celestial mechanics; and radioastronomy.

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06 AUXILIARY SYSTEMS 2033

Includes: fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters.

For primary propulsion systems see: 27 Propulsion.

For related information see: 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; and 22 Navigation and Guidance.

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Includes: circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory.

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For related information see: 16 Life Sciences.

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Includes: design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; and sensors and transducers.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

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Includes: biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness.

For related information see: 14 Human Behavior; and 28 Space Radiation.

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For related information see: 06 Auxiliary Systems.

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Includes: autopilots; star tracking; inertial platforms; and traffic control.

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Includes: fuels; igniters; and oxidizers.

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Includes: cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts.

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Includes: space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories.

For space biology see: 16 Life Sciences.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

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Includes: structural elements; and weight analysis.

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A Semimonthly Publication
of the National Aeronautics and Space Administration

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01 GENERAL

Includes: management; space law and legal matters; symposia or conferences of a broad or a general nature.

N63-23071 American Academy of Arts and Sciences, Cambridge, Mass. Committee on Space
BUSINESSMEN REVIEW THE SPACE EFFORT
Edward E. Furash Repr. from Harvard Business Rev., v. 41, no. 5, Sept.–Oct. 1963 21 p refs
(NASA Grant NsG-253-62)
(NASA CR-51798)

Businessmen continue to believe strongly that the Nation's space program is both worthwhile and important. But the novelty of space has worn off, and their enthusiasm has a distinctly different cast to it. Executives are considerably better informed about the space program now than they were in 1960, and this knowledge is reflected in a more critical examination of the space program and the issues surrounding it. Whether as a function of passing time or of their increased knowledge, businessmen appear to have put the space program in perspective. For example, there is general agreement that space spending is just about right and that a speedup is not a matter of high priority. I.v.L.

N63-23074 Congress. House. Committee on Sciences and Astronautics
AUTHORIZING APPROPRIATIONS TO THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION Report of the Committee on Science and Astronautics, U.S. House of Representatives
George P. Miller Washington, GPO, 1963 206 p
(88th Cong. 1st Sess. H. R. 591 Committee Print)

The report of the Committee on Science and Astronautics of the U.S. House of Representatives on H.R. 7500, recommending appropriations to NASA for research and development, construction of facilities, and administrative operations is presented. A descriptive summary of the projects within these categories and the appropriations authorized for each is included. M.P.G.

N63-23108 George Washington U., Alexandria, Va. Training Methods Div.
A DESCRIPTION OF SNAP PROGRAMMING Research Memorandum
Edgar L. Shriver and Robert C. Trexler May 1963 23 p
(Contract DA-44-188-ARO-2)

"SNAP" programing (Socratic Non-Anacoluthic Programing), a type of programing which is designed as a simple way of producing programed materials (under certain conditions) rather than as a method for producing more refined programs, is described. The conditions for the original development and application of SNAP programing were: (1) students were to learn how to trouble shoot a new radar system; (2) students had prior training and experience with similar radars; (3) programers had varying, but generally high degrees of familiarity with the course content; and (4) course material was derived from a task analysis which ensured the relevance of the course content to the student's ultimate task. P.V.E.

N63-23172 Bolt, Beranek and Newman, Inc., Cambridge, Mass.
THE SOCRATIC SYSTEM: A COMPUTER SYSTEM TO AID IN TEACHING COMPLEX CONCEPTS
John A. Swets, Wallace Feurzeig, Judith R. Harris, and Thomas Marill Wright-Patterson AFB, Training Res. Div., Ohio, June 1963 46 p 4 refs
(Contract AF 33(657)-9126)
(AMRL Memo. P-43)

This report presents a general rationale, approach, and instrumentation for research on the use of a digital computer to aid in teaching complex concepts, problem solving, etc. Two computer-controlled instructional systems are described. These systems are considered as early prototypes of teaching systems in which the student has full control over the progression of a complex lesson. Author

N63-23201 American Inst. of Aeronautics and Astronautics, New York, N.Y.
2ND MANNED SPACE FLIGHT MEETING
[1963] 402 p refs A Volume of Technical Papers Presented at Dallas, Apr. 22–24, 1963
(Co-sponsored by NASA)
AIAA: $7.00 members, $12.00 nonmembers

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N63-23235 Chance Vought Corp., Dallas, Tex.
RESEARCH REQUIREMENTS: LIFE SCIENCES RESEARCH NEEDS
Charles F. Gell *In* AIAA 2nd Manned Space Flight Meeting [1963] p 274–278 refs (See N63-23201 24-01)

What has been accomplished and what remains to be done in studying the effects of the following physical stressors found in space are discussed: (1) physical stressors inherent in space—(a) total lack of livable atmosphere, (b) extreme temperature variations, (c) presence of ionizing radiations, (d) presence of meteoroids, (e) absence of terrestrial gravity, and (f) absence of terrestrial magnetic force; (2) physical stressors generated in the space ship—(a) acceleration stresses on escape (reentry and abort of vehicle), (b) noise, (c) vibration, and (d) ultrasonics; (3) stressors generated by man himself—(a) toxic contamination, (b) waste-disposal requirement, (c) sustenance requirements, and (d) maintainance of health and body tone in the space man; and (4) behavioral stressor mechanisms—(a) psychological effects of spaceflight on man, (b) effect of mixed stressors, (c) biological monitoring–psychophysiological correlation, and (d) training requirements. P.V.E.

N63-23238 Massachusetts Inst. of Tech., Cambridge
RESEARCH NEEDS FOR ENERGY CONVERSION SYSTEMS
David C. White *In* AIAA 2nd Manned Space Flight Meeting [1963] p 308–328 refs (See N63-23201 24-01)

Research needs for energy conversion systems in the space program are discussed in the following areas: (1) review of current manned space missions requirements, (2) review of future manned mission requirements, (3) energy conversion systems for manned spaceflight, and (4) status review and research needs; energy conversion systems and devices—solar cells, thermionic converters, thermoelectric generators, MHD power generation, dynamic systems, fuel cells, batteries, and biocells. Based on this review, it is concluded that energy conversion systems for manned space travel during the next decade must come from conversion processes whose basic fundamentals are known today and that the power requirements needed for manned space exploration in the next two to three decades cannot be met with existing systems. P.V.E.

N63-23243 Paris U., Orsay (France) Lab. de l'Accélérateur Linéaire
INVESTIGATION OF DENSITY EFFECT IN SOLIDS AND GASES Final Technical Report
[1962] 119 p refs
(Contract DA-91-591-EUC-2011)

CONTENTS:

1. THE PRESSURE DEPENDENCE OF IONIZATION BY RELATIVISTIC ELECTRONS T. Aggson and R. Morrison 9 p refs (See N63-23244 24-23)

2. IONIZATION BY RELATIVISTIC PARTICLES IN HELIUM HYDROGEN GAS MIXTURES T. Aggson 9 p refs (See N63-23245 24-23)

3. STRAGGLING OF ENERGY LOSS BY HIGH ENERGY ELECTRONS IN SOLIDS G. R. Bishop 10 p (See N63-23246 24-25)

4. THE SECONDARY EMISSION MONITOR 34 p (See N63-23247 24-15)

5. DIRECT ELECTRON-POSITRON PAIR PRODUCTION BY 150 MEV ELECTRONS T. Aggson 26 p refs (See N63-23248 24-23)

6. DENSITY EFFECT IN SOLIDS AND THE STRAGGLING CURVE OF ENERGY LOSS BY RELATIVISTIC ELECTRONS G. R. Bishops 22 p refs (See N63-23249 24-25)

N63-23301 Air Force Cambridge Research Labs., Bedford, Mass. Terrestrial Sci. Lab.
A COMPENDIUM OF PAPERS IN THE FIELDS OF GEODESY AND PLANETARY GEOMETRY PREPARED AT AFCRL DURING 1962 Research Report
Owen W. Williams, ed. Aug. 1963 233 p refs
(AFCRL-63-876)

CONTENTS:

1. GEODETIC APPLICATIONS IN THE SPACE AGE O. W. Williams 8 p (See N63-23302 24-12)

2. A REVIEW OF THE MOON'S ROTATION AND MECHANICAL FIGURE FROM HELIOMETER OBSERVATIONS M. S. Hunt and D. H. Eckhardt 19 p refs (See N63-23303 24-05)

3. LARGOS: A SUGGESTED METHOD FOR STEREOTRIANGULATION M. S. Tavenner 9 p refs (See N63-23304 24-05)

4. OPERATIONAL CONCEPTS OF PHOTOGRAMMETRIC DETERMINATION OF AZIMUTHS OVER INTERMEDIATE DISTANCES M. S. Tavenner and P. B. Swenson 14 p refs (See N63-23305 24-08)

5. THREE DIMENSIONAL GEODESY AND AN EARTH-CENTERED COORDINATE SYSTEM O. W. Williams 12 p (See N63-23306 24-12)

6. PROJECT SCORPIO: A PROPOSED SATELLITE SYSTEM FOR IMPROVING ATLANTIC MISSILE RANGE ACCURACY AND CALIBRATING OPERATIONAL MISSILE RANGING SYSTEMS Technical Proposal A. Mancini, H. R. Kahler, and C. Warner 52 p (See N63-23307 24-30)

7. ANNA: A FLASHING SATELLITE M. S. Tavenner 10 p refs (See N63-23308 24-12)

8. GEODESY'S NEWEST DIMENSION L. L. Sheldon 13 p refs (See N63-23309 24-12)

9. GEODESY: PROMISE AND PROGRESS O. W. Williams 12 p (See N63-23310 24-12)

10. A STATISTICAL APPROACH TO LUNAR GEOMETRY D. H. Eckhardt and M. S. Hunt 23 p refs (See N63-23311 24-29)

11. GEODETIC APPLICATIONS OF LASERS P. B. Swenson 4 p (See N63-23312 24-25)

12. PRELIMINARY REPORT ON THE OPTICAL SYSTEM FOR THE ANNA GEODETIC SATELLITE O. W. Williams and A. Mancini 18 p (See N63-23313 24-12)

N63-23314 Aeronautical Systems Div., Wright-Patterson AFB, Ohio Flight Accessories Lab.
PROCEEDINGS OF RETARDATION AND RECOVERY SYMPOSIUM [DAYTON, NOVEMBER 13-14, 1962 Final Report]
May 1963 507 p refs
(ASD-TDR-63-329; AD-408772)

CONTENTS:

I. HYPERSONIC SESSION

1. HEATING PROBLEM FOR SUPERSATELLITE REENTRY P. H. Rose (Avco-Everett Res. Lab.) p 14–33 refs (See N63-23315 24-13)

2. SOME CONSIDERATIONS FOR RE-ENTRY CONFIGURATIONS RELATIVE TO MISSION AND TECHNICAL CONSTRAINTS A. C. Draper and L. L. Buck (Directorate of Aeromechanics) p 34–85 refs (See N63-23316 24-02)

II. SUPERSONIC SESSION

3. SUPERSONIC PARACHUTE RESEARCH R. J. Berndt and C. A. Babish III (Directorate of Aeromechanics) p 112–157 refs (See N63-23317 24-03)

4. APPLICATION OF AXISYMMETRIC FLOW ANALYSIS TO INFLATION STABILITY OF SUPERSONIC FLEXIBLE PARACHUTES J. K. Buckner (Gen./Dynamics) p 158–193 refs (See N63-23318 24-02)

5. FLEXIBLE WING RESEARCH AND DEVELOPMENT F. M. Rogallo (NASA, Langley Res. Center) p 195–213 refs (See N63-23319 24-03)

6. HIGH TEMPERATURE FIBROUS MATERIALS FOR DECELERATORS J. H. Ross (Directorate of Mater. and Processes) p 215–233 refs (See N63-23320 24-13)

III. DECELERATOR INVESTIGATIONS SESSION

7. THE VELOCITY AND PRESSURE DISTRIBUTION IN THE WAKE OF A BODY OF REVOLUTION AT TRANSONIC AND SUPERSONIC SPEED H. G. Heinrich and R. S. Hess (Minn. U.) p 235–279 (See N63-23321 24-02)

8. RELIABILITY OF RECOVERY SYSTEMS—EVALUATION AND ATTAINMENT G. Chernowitz (Am. Power Jet Co.) p 280–315 refs (See N63-23322 24-04)

9. WATER SURFACE WAVE ANALOGY AND APPLICATIONS TO PROBLEMS OF AERODYNAMIC DECELERATION S. K. Ibrahim (Minn. U.) p 316–367 refs (See N63-23323 24-02)

10. PARAVULCOON RECOVERY AND LANDING SYSTEM A. J. Oberg, S. S. Sopczak, and M. A. Sutton (Minn.-Honeywell Reg. Co.) p 368–416 refs (See N63-23324 24-03)

IV. GENERAL CONSIDERATIONS SESSION

11. SYSTEMS CONSIDERATIONS T. W. Knacke (Northrop Corp.) p 418–441 refs (See N63-23325 24-06)

12. NEW PARACHUTE DEVELOPMENT ASPECTS A. M. Hegele, C. E. Carroll, H. Engel, Jr. (Directorate of Operational Support Eng.) p 442–460 refs (See N63-23326 24-02)

13. TECHNICAL AREA OUTLOOK G. A. Solt, Jr. (Flight Accessories Lab.) p 461–470 (See N63-23327 24-02)

N63-23353 North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
ULTRASONIC CLEANING: A BIBLIOGRAPHY
Mar. 1, 1963 19 p 105 refs Covers periodical articles published during 1953–1962
(SID-63-167)

N63-23412 American Astronautical Society, New York, N.Y.
SCIENTIFIC SATELLITES
Irving E. Jeter, ed. (RCA) 1963 263 p refs Proc. of an AAS Symp. on Sci. Satellites—Mission and Design, Philadelphia, Dec. 27, 1962
(Co-sponsored by NASA)
(*Its* Advances in the Astron. Sci., Vol. 12)

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1. SCIENTIFIC SATELLITES—A PERSPECTIVE B. A. Kossiakoff (Appl. Phys. Lab.) p 1–17 (See N63-23413 24-32)

2. S-6, AN AERONOMY SATELLITE R. Horowitz (NASA, Wash.) p 19–39 (See N63-23414 24-32)

3. TOPSIDE SOUNDING OF THE IONOSPHERE J. H. Chapman (DRTE, Canada) p 41–63 (See N63-23415 24-12)

4. THE NASA TOPSIDE SOUNDER PROGRAM L. J. Blumle, R. J. Fitzenreiter, and J. E. Jackson (NASA, Goddard Space Flight Center) p 65–95 refs (See N63-23416 24-12)

5. GEOPHYSICAL RESEARCH WITH SATELLITES INJUNS I, II, AND III B. J. O'Brien (Iowa State U.) p 97–125 refs (See N63-11323 03-12)

6. THE MISSION OF THE ORBITING GEOPHYSICAL OBSERVATORIES W. E. Scull (NASA, Goddard Space Flight Center) p 127–148 (See N63-15167 11-32)

7. THE ENGINEERING DESIGN OF THE ORBITING GEOPHYSICAL OBSERVATORIES G. J. Gleghorn (Space Technol. Labs., Inc.) p 149–174 refs (See N63-15168 11-32)

8. THE MISSION OF THE ADVANCED ORBITING SOLAR OBSERVATORY J. C. Lindsay (NASA, Goddard Space Flight Center) p 175–186 (N63-15169 11-32)

9. ONE APPROACH TO THE ENGINEERING DESIGN OF THE ADVANCED ORBITING SOLAR OBSERVATORY A. J. Cervenka (NASA, Goddard Space Flight Center) p 187–215 (See N63-15170 11-32)

10. THE MISSION OF THE ORBITING ASTRONOMICAL OBSERVATORY R. R. Ziemer and J. E. Kupperian, Jr. (NASA, Goddard Space Flight Center) p 217–233 refs (See N63-15171 11-32)

11. THE ENGINEERING DESIGN OF THE ORBITING ASTRONOMICAL OBSERVATORY W. H. Scott, Jr. (Grumman Aircraft Eng. Corp.) p 235–255 refs (See N63-15172 11-32)

N63-23421 Congress. Senate. Committee on Aeronautical and Space Sciences
AUTHORIZING APPROPRIATIONS TO THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION Report of the Committee on Aeronautical and Space Sciences, U.S. Senate; H. R. 7500, Aug. 2, 1963
Clinton P. Anderson, Washington, GPO, 1963 358 p
(88th Cong. 1st Session. Senate Rept. 385)

The Committee on Aeronautical and Space Sciences has reviewed and recommended for passage H. R. 7500. This bill authorizes appropriations to the National Aeronautics and Space Administration for research and development, construction of facilities, administrative operations, and other purposes.
J.E.T.

N63-23436 United States Information Agency, Washington, D.C.
VOICE OF AMERICA FORUM SERIES ON SPACE SCIENCE, TWENTY LECTURES, JANUARY 8-MAY 21, 1962
312 p

CONTENTS:

1. THE CHALLENGES OF SPACE H. Odishaw (Natl. Acad. of Sci.) p 1–18 (See N63-23437 24-01)

2. METEOROLOGICAL SATELLITES AND WEATHER FORECASTING D. S. Johnson (Weather Bur.) p 19–34 (See N63-23438 24-21)

3. INTERNATIONAL COMMUNICATION AND SPACE J. R. Pierce (Bell Telephone Labs., Inc.) p 35–49 (See N63-23439 24-08)

4. GEODETIC APPLICATIONS IN THE SPACE AGE O. W. Williams (AFCRL) p 51–66 (See N63-23302 24-12)

5. SUN AND EARTH H. Friedman (Naval Res. Lab.) p 67–82 (See N63-23440 24-29)

6. GEOMAGNETISM J. P. Heppner (NASA, Goddard Space Flight Center) p 83–97 (See N63-23441 24-12)

7. THE IONOSPHERE A. H. Shapley (NBS) p 99–110 (See N63-23442 24-12)

8. THE AURORA J. W. Chamberlain (Yerkes Obs.) p 111–122 (See N63-23443 24-12)

9. SPACE RESEARCH AND METEOROLOGY H. Wexler (Weather Bur.) p 123–137 (See N63-23444 24-21)

10. RESEARCH IN GEODESY G. P. Woollard (Wis. U.) p 139–155 (See N63-23445 24-12)

11. GRAVITATION AND SPACE SCIENCE R. H. Dicke (Princeton U.) p 159–171 (See N63-23446 24-29)

12. THE EARTH AND NEAR SPACE J. A. Van Allen (Iowa State U.) p 173–191 (See N63-23447 24-28)

13. THE INTERPLANETARY MEDIUM J. A. Simpson (Chicago U.) p 193–205 (See N63-23448 24-29)

14. THE MOON G. J. F. Mac Donald (Calif. U.) p 207–220 (See N63-13486 10-28)

15. EXPLORATION OF THE NEARER PLANETS G. de Vaucouleurs (Texas U.) p 221–237 (See N63-23449 24-29)

16. THE SUN L. Goldberg (Harvard Coll. Obs.) p 239–252 (See N63-23450 24-29)

17. ASTRONOMY IN THE SPACE AGE E. R. Dyer, Jr. (Natl. Acad. of Sci.) p 253–267 (S N63-23451 24-05)

18. MANNED EXPLORATION OF SPACE C. J. Lambertsen (Penn. U.) p 270–282 (See N63-23452 24-32)

19. SPACE AND THE LIFE SCIENCES C. S. Pittendrigh (Princeton U.) p 283–296 (See N63-23453 24-16)

20. LIFE BEYOND THE EARTH C. Sagan (Calif. U.) p 297–310 (See N63-23454 24-16)

N63-23437 National Academy of Sciences, Washington, D.C. Space Science Board

THE CHALLENGES OF SPACE

Hugh Odishaw *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 1–18 (See N63-23436 24-01) (Lecture 1)

The basic motivation for efforts in space is discussed. The first, and perhaps basic, reasons are adventure and exploration, as exemplified by the man-in-space programs of the U.S. and the U.S.S.R. The second reason is the utilitarian and economic application of science and engineering in near space, as exemplified by meteorological, communications, and navigation satellites. The third reason is the pursuit of intellectual knowledge about the universe. Some accomplishments of space sciences are reviewed, and the broad spectrum of as yet unanswered questions about the universe is sketched. The challenging opportunities of space offer an unparalleled opportunity for cooperation among men and nations. Preliminary steps in this direction include IGY and COSPAR accomplishments. M.P.G.

N63-23539 Carnegie Institution of Washington, D.C.

ANNUAL REPORT OF THE DIRECTOR OF THE DEPARTMENT OF TERRESTRIAL MAGNETISM, 1961-1962

Merle A. Tuve Dec. 10, 1962 88 p refs Repr. from the Carnegie Inst. of Washington Year Book 61, July 1, 1961–June 30, 1962

CONTENTS:

1. EXPERIMENTAL GEOPHYSICS B. F. Burke and M. A. Tuve p 214–239 refs (See N63-23540 24-12)

2. THEORETICAL AND STATISTICAL GEOPHYSICS S. E. Forbush p 239–241 refs (See N63-23541 24-12)

3. LABORATORY PHYSICS L. Brown, N. P. Heydenburg, H. Rudin, and G. M. Temmer p 242–244 refs (See N63-23542 24-23)

4. BIOPHYSICS E. T. Bolton, R. J. Britten, D. B. Cowie, B. J. Mc Carthy, J. E. Midgley, and R. B. Roberts p 244–290 refs (See N63-23543 24-16)

N63-23547 Joint Publications Research Service, Washington, D.C.

SOVIET ATMOSPHERIC AND MARINE RESEARCH

Oct. 11, 1963 23 p Transl. into ENGLISH of selected articles from Vestnik Akad. Nauk SSSR (Moscow), no. 8, 1963 (JPRS-21412; OTS-63-31919) OTS: $0.75

CONTENTS:

1. WEATHER FORECASTING AND PROBLEMS OF ATMOSPHERIC PHYSICS p 1–3 (See N63-23548 24-21)

2. STUDIES IN THE PHYSICS OF THE UPPER ATMOSPHERE N. I. Fedorova p 17–20 (See N63-23549 24-12)

N63-23588 Lockheed-California Co., Burbank

SPACE PROGRAMS 1962-1975

E. E. Whitney July 1963 21 p

A list of projected space program is presented for the period 1962–1975, and includes the following information: booster to be used for the launch, designation, name, dimensions, costs, and scheduled launching date. P.V.E.

N63-23600 Congress. House. Committee on Appropriations.

INDEPENDENT OFFICES APPROPRIATIONS FOR 1964, PART 3. HEARINGS BEFORE A SUBCOMMITTEE OF THE COMMITTEE ON APPROPRIATIONS HOUSE OF REPRESENTATIVES, EIGHTY-EIGHTH CONGRESS, FIRST SESSION

1963 1210 p

Areas of discussion at hearings before a subcommittee of the Committee on Appropriations, House of Representatives, Eighty-eighth Congress, First Session, included civil defense, civil supersonic aircraft development, National Aeronautics and Space Administration, National Aeronautics and Space Council. C.L.W.

N63-23710 Battelle Memorial Inst., Columbus, Ohio

PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JUNE 1963

Russell W. Dayton and Ronald F. Dickerson July 1, 1963 75 p 4 refs

(Contract W-7405-eng-92)

(BMI-1639(Del.)) OTS: $1.75

Progress relating to civilian application is reported for these areas: reactor materials and components; studies of nuclear fuels; fuel-element development; radioisotope and radiation applications; development of a tracer system for in-place filter evaluation; coated-particle fuel materials; material development and fuel irradiation; supporting nuclear research; corrosion studies of the fluoride-volatility process; creep rupture of sintered aluminum powder alloys and mechanical properties of zirconium alloys; fission-product deposition studies; irradiation of materials and components; gas-cooled reactor studies; and joining of regenerative cell components. C.L.W.

N63-23799 Lockheed Missiles and Space Co., Sunnyvale, Calif.

COST ESTIMATING FOR RESEARCH, DEVELOPMENT, AND INFORMATION PROCESSING PROGRAMS: AN ANNOTATED BIBLIOGRAPHY

Eugene E. Graziano, comp. Oct. 1963 19 p refs

(LMSC SB-63-70)

This bibliography is the result of a literature search on methods for estimating costs, particularly relating to manpower requirements, for aerospace R and D, engineering, information processing, and advanced programs. It has appeared from this study that methods for cost estimation might best be developed by the adaption of cost control methods. Author

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes: aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc.

For related information see: 03 Aerodynamics of Wings, Rotors and Control Surfaces; and 11 Fluid Mechanics.

N63-23033 Douglas Aircraft Co., Inc., Santa Monica, Calif.
WIND TUNNEL INVESTIGATION OF TURBULENT BOUNDARY LAYER NOISE AS RELATED TO DESIGN CRITERIA FOR HIGH PERFORMANCE VEHICLES
J. S. Murphy, D. A. Bies (Bolt, Beranek and Newman, Inc.), W. V. Speaker, and P. A. Franken July 1963 90 p 39 refs
(NASA Contract NASr-110, S.O. 111213-57197)
(NASA CR-51730) OTS: $8.10 ph, $2.90 mf

Experimentally determined data on the magnitude of wall pressure fluctuation levels for turbulent boundary layers are presented. The measurements were made on the sidewall of the Trisonic One-Foot Tunnel which was modified to eliminate background noise in the test stream normally associated with choked flow over the pressure-control valve. A small condenser microphone was used which limited measurements to frequencies below 88,000 cps, a range to which practical vehicle structure can respond. Results are presented for the zero pressure gradient or flat plate boundary layer on an insulated surface for free-stream Mach numbers of 0.43, 0.59, 0.86, 1.41, 1.80, 2.52, and 3.46 and Reynolds number based on momentum thickness in the range $14 \times 10^3 < R_\theta < 50 \times 10^3$. Author

N63-23050 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
LOW-DENSITY SPHERE DRAG WITH EQUILIBRIUM AND NONEQUILIBRIUM WALL TEMPERATURE
Harry Ashkenas Aug. 1963 14 p 15 refs Repr. from 3rd Internatl. Rarefied Gas Dyn. Symp., v. 2, p 278–290 N.Y. Academic Press, 1963
(NASA Contract NAS7-100)
(NASA CR-52015; JPL-TR-32-442)

The drag of a sphere in a supersonic low-density flow has been measured under both equilibrium and nonequilibrium surface temperature conditions. The simple deflection technique has been exploited to yield drag data for free-stream Mach numbers between 1.8 and 4.4, free-stream Reynolds numbers between 3 and 125, and free-stream Knudsen numbers between 1 and 0.05. Radiation heating of the sphere models has produced wall temperatures as high as 1860° R (= 1033° K) resulting in wall-to-free-stream temperature ratios up to 15; the drag increase due to heating has been measured at up to 25% of the equilibrium wall temperature value. Author

N63-23101 University of Southern Calif. Engineering Center, Los Angeles
INVESTIGATION OF AIR INJECTION AS A MEANS OF PRODUCING SHOCK-COMPRESSION SYSTEMS IN SUPERSONIC INLETS
D. A. Wallace Sept. 20, 1963 14 p
(USCEC 65-55)

A description of tests on a model designed to provide preliminary information of the nature of the "jet-main flow" interaction is presented. Two approaches to the problem of compressing the inlet airflow with auxiliary injected air are considered: (1) the air may be injected normal to the primary flow causing flow separation and a deflected free jet; and (2) the air is introduced through a cascade of nozzles in such a way that primary flow is aerodynamically deflected in a series of small steps. Conclusions resulting from the tests include: (1) the stagnate air zone created downstream of a normal injector makes it difficult to position the transition normal shock waves in the region of maximum supersonic compression; and (2) a cascade injector can be designed for efficient (at one particular flow condition) pressure recovery, and avoids the stagnate region associated with the normal injector. P.V.E.

N63-23102 University of Southern Calif. Engineering Center, Los Angeles
WING-TAIL INTERFERENCE EXPERIMENTS AT SUPERSONIC SPEEDS
John B. Wainwright Mar. 15, 1963 14 p 2 refs
(USCEC 65-56)

Measurement of wing–tail interference effects, in the Mach-number range 1.6 to 3.5, were carried out in order to establish a set of experimental data which could be used to evaluate the utility of prevailing aerodynamic theory, as applied to the design of a supersonic missile configuration. The parameters which govern the effects of wing–tail interference are wing and tail lift coefficients, the aspect ratio and taper ratio of the tail, the ratio of body diameter to tail span, and the location of the wing vortex relative to the tail center of lift. Summary plots are presented for experimental-vs-estimated lift-curve slopes for all combinations investigated, differences between estimated and measured lift slopes for the wing–body and tail–body combinations, and the differences between estimated and measured lift slopes for wing–body–tail combinations. P.V.E.

N63-23188 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
APPLICATION OF GALERKIN'S METHOD IN DESIGNING AN AIRPLANE WING AGAINST FLUTTER
O. I. Lotkin Sept. 19, 1963 11 p 6 refs Transl. into ENGLISH from book, "Institut Mekhaniki Akademii Nauk Soyuza SSR, Inzhenernyy Sbornik, v. 6," 1950 p 153–160
(FTD-TT-63-739/1+2)

The use of Galerkin's method with a chosen eigenfunction for the first approximation, which satisfies not only the boundary conditions of the problem but also the differential equation itself at the points of the boundary and the consequent higher derivatives, is demonstrated. The validity of this method is shown using the example of the longitudinal bending of a bar. The method is then used in the determination of eigenvalues in the problem of wing flutter. The results obtained are comparable with the precise solution computed using a fifth approximation according to Picard. M.P.G.

N63-23199 Advisory Group for Aeronautical Research and Development, Paris (France)
AGARD AERONAUTICAL MULTILINGUAL DICTIONARY First Supplement
A. H. Holloway, ed. Oxford, N.Y., Pergamon Press, 1963 340 p In ENGLISH, FRENCH, GERMAN, SPANISH, GREEK, ITALIAN, DUTCH, RUSSIAN, and TURKISH
Available from the Macmillan Co., N.Y.: $14.00 or 70s

This first supplement to the Agard Aeronautical Multilingual Dictionary represents an expansion of the material in the original AGARD dictionary published in 1960. The entries are defined in English only, and the German, Spanish, French, Greek, Italian, Dutch, Russian, and Turkish equivalents of the English words are indexed. M.P.G.

N63-23222 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LATERAL-RANGE AND HYPERSONIC LIFT-DRAG-RATIO REQUIREMENTS FOR EFFICIENT FERRY SERVICE FROM A NEAR-EARTH MANNED SPACE STATION
Donald L. Baradell and Charles H. Mc Lellan *In* AIAA 2nd Manned Space Flight Meeting [1963] p 159-166 refs (See N63-23201 24-01)

The geometry of the ferry ranging problem, that is, the lateral ranges required to reach chosen landing sites from various near-earth orbits, is examined, and the investigation and comparison of several means to achieve these ranges are discussed. The particular case considered is that of returning from a space station which is in a circular orbit at an altitude of 200 statute miles. From this orbit, the vehicle will retro and reenter at very close to satellite velocity. The downrange problem can be handled by proper timing of the retrofiring, and the desired lateral range can be achieved by aerodynamics, space propulsion to change orbit plane, atmospheric propulsion, or combinations of these methods. The relative cost in terms of weight of using these different methods to achieve lateral range is discussed. I.v.L.

N63-23223 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A LOOK AT MANNED ENTRY AT CIRCULAR TO HYPERBOLIC VELOCITIES
E. S. Love and E. B. Pritchard *In* AIAA 2nd Manned Space Flight Meeting [1963] p 167-180 refs (See N63-23201 24-01)

The environment associated with manned entry is reviewed with the objective of hopefully arriving at an entry vehicle class that shows promise of future mission versatility and a capability of entry over a range of entry velocities from circular to hyperbolic without large penalties for aerodynamic performance. Such a multipurpose entry vehicle is shown to be feasible to the degree that it would appear to merit further study in consideration of future entry vehicle needs. Author

N63-23236 Avco-Everett Research Lab., Everett, Mass.
FUTURE PROBLEMS IN RE-ENTRY PHYSICS
Peter H. Rose *In* AIAA 2nd Manned Space Flight Meeting [1963] p 279-294 refs (See N63-23201 24-01)

Reentry technology today is based on a broad research foundation developed in support of missile and satellite programs. The heating problem of all reentry vehicles designed to date has been dominated by convective heating considerations with a significant but secondary role being played by radiative heat flux. The considerations presented lead to the conclusion that, although reentry velocities higher than escape speed are certainly of interest for future entry systems, there are some very solid limitations which must be considered. Even the best presently known heat protection materials will be insufficient to allow survival of a significant payload fraction at entry velocities above 100,000 ft/sec. On the other hand, manned vehicles will probably be limited to reentry velocities closer to 70,000 ft/sec. P.V.E.

N63-23316 Directorate of Aeromechanics, Aeronautical Systems Div., Wright-Patterson AFB, Ohio
SOME CONSIDERATIONS FOR RE-ENTRY CONFIGURATIONS RELATIVE TO MISSION AND TECHNICAL CONSTRAINTS
Alfred C. Draper and Melvin L. Buck *In* Aeron. Systems Div. Proc. of Retardation and Recovery Symp., Dayton, Nov. 13-14 p 34-85 refs (See N63-23314 24-01)

A review is made of the various types of configurations considered suitable for reentry at hypervelocity speeds. These configurations are viewed relative to a series of mission applications increasing in complexity from pure weapon delivery to sophisticated manned reentry. Design trends and considerations peculiar to the various regions of reentry flight from hyperbolic to the terminal phases are outlined with proposed methods for solution. Particular emphasis is placed on delineating the constraints peculiar to reentry from superorbital velocities, and the advantages and requirements associated with certain aerodynamic designs are discussed in detail. Future design requirements and long-term goals are viewed from the separate considerations of mission applications, technical constraints, optimization parameters, and growth potential. Author

N63-23318 General Dynamics/Fort Worth, Tex.
APPLICATION OF AXISYMMETRIC FLOW ANALYSIS TO INFLATION STABILITY OF SUPERSONIC FLEXIBLE PARACHUTES
J. K. Buckner *In* Aeron. Systems Div. Proc. of Retardation and Recovery Symp., Dayton, Nov. 13-14 1962 p 158-193 refs (See N63-23314 24-01)

An axisymmetric flow analysis is performed on supersonic porous parachutes utilizing available data from tests of three different parachute designs. Photographs of the flow field near various parachute models have been studied to establish a hypothesis concerning the nature and causes of inflation instability. With careful consideration given to the uniqueness of each parachute geometry, and the assumptions necessary to establish the flow field, the upper porosity-Mach number limit for stable operation of a 30° Conical, a 15% Skirted Equiflo, and a 10% Skirted Hemisflo parachute is calculated. Author

N63-23321 Minnesota U., Minneapolis
THE VELOCITY AND PRESSURE DISTRIBUTION IN THE WAKE OF A BODY OF REVOLUTION AT TRANSONIC AND SUPERSONIC SPEED
Helmut G. Heinrich and R. Sheldon Hess *In* Aeron. Systems Div. Proc. of Retardation and Recovery Symp., Dayton, Nov. 13-14, 1962 p 235-279 (See N63-23314 24-01) (Sponsored jointly by AF, Army, and Navy)

The basic problems of the flow-field analysis of the wake in subsonic flow are discussed, and the principles of the analytical approaches are reviewed. Experimental results of the distribution of static pressure and Mach number along the axis, and the total pressure profiles across the wake in transonic and supersonic flow, are presented. Author

N63-23323 Minnesota U., Minneapolis
WATER SURFACE WAVE ANALOGY AND APPLICATIONS TO PROBLEMS OF AERODYNAMIC DECELERATION
Shukry K. Ibrahim *In* Aeron. Systems Div. Proc. of Retardation and Recovery Symp., Dayton, Nov. 13-14, 1962 p 316-367 refs (See N63-23314 24-01)

This paper briefly reports the chronological development of the analogy, presents a summary of its basic theory, describes the facilities developed with particular emphasis on the recently completed moving water channel, outlines the experimental procedures adopted, and discusses some of the results achieved and potential lines for further development. Author

N63-23326 Directorate of Operational Support Engineering, Aeronautical Systems Div., Wright-Patterson AFB, Ohio
NEW PARACHUTE DEVELOPMENT ASPECTS

Alfons M. Hegele, Charles E. Carroll, and Herman Engel, Jr. *In* Aeron. Systems Div. Proc. of Retardation and Recovery Symp., Dayton, Nov. 13-14, 1962 p 442-460 refs (See N63-23314 24-01)

This paper describes the development programs which have been lately conducted to improve the design and performance of parachute assemblies and related equipment with the aim of providing safer and more reliable items, and of defining the progress made in the air drop of equipment. Author

N63-23327 Aeronautical Systems Div., Wright-Patterson AFB, Ohio Flight Accessories Lab.
TECHNICAL AREA OUTLOOK AERODYNAMIC DECELERATOR: THEIR USE AND FUTURE
George A. Solt, Jr. *In its* Proc. of Retardation and Recovery Symp., Dayton, Nov. 13-14, 1962 p 461-470 (See N63-23314 24-01)

A discussion is presented of military and scientific objectives in which the decelerator will serve as a useful, and sometimes mandatory, tool to assure successful achievement of the objectives. Decelerator capabilities required for the future are also considered. P.V.E.

N63-23363 National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
EXPERIMENTAL AND CALCULATED RESULTS OF A FLUTTER INVESTIGATION OF SOME VERY LOW ASPECT-RATIO FLAT-PLATE SURFACES AT MACH NUMBERS FROM 0.62 TO 3.00
Perry W. Hanson and Gilbert M. Levey Washington, NASA, Oct. 1963 25 p refs
(NASA TN D-2038; supersedes NASA TM X-53) OTS: $0.75

Two types of planforms, a delta and a delta with one-third span cut off, are used in this investigation. Three different panel aspect ratios, 0.728, 0.536, and 0.353, were tested for each type of planform. Each model had a 12-inch root chord, and was cantilevered from the tunnel wall. Generally, the clipped-tip-delta planforms were more susceptible to flutter throughout the Mach number range investigated. The lower aspect-ratio models fluttered at a higher value of the stiffness-altitude parameter than the higher aspect-ratio models for a given type of planform and a given Mach number. Author

N63-23388 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
WIND TUNNEL
A. M. Mkhitaryan, V. S. Maksimov et al July 16, 1963 6 p Transl. into ENGLISH from Russian Patent 141758, (Appl. 686830/40-23., Nov. 26, 1960) p 1-2
(FTD-TT-63-646/1+2)

A wind tunnel to be used in investigating boundary layers in a semirestricted stream, under conditions of gradientless and gradient flow at high flow velocities and constant pressure, is described. The working section of the tunnel is made in the form of a rectangular trough with solid bottom and side walls, and with a flexible movable plate for the upper wall. P.V.E.

N63-23423 Cornell Aeronautical Lab., Buffalo, N.Y.
EFFECTS OF AMBIENT NONUNIFORMITIES IN FLOW OVER HYPERSONIC TEST BODIES
J. Gordon Hall Aug. 1963 64 p 10 refs
(CAL Rept. 128)

Perturbation analyses are made of nonuniform ambient flow effects on the flow fields of sharp and blunt hypersonic test bodies. For pointed slender bodies, the Newtonian-flow estimate for nonuniform-flow effects on surface pressure is generalized for arbitrary axisymmetric or plane profiles including centrifugal effects. For blunted slender bodies, a flow model previously introduced by Cheng for uniform ambient flow is extended to provide a convenient perturbation approach to nonuniform-flow effects on surface pressure and shock shape for arbitrary axisymmetric or plane profiles. The effects of source-type ambient flow are generally to reduce the body surface pressure, as compared to that for uniform ambient flow, and displace the shock wave away from the body. The reduction of surface pressure is quite strong for pointed slender bodies, although somewhat less severe on convex bodies because of centrifugal effects. In contrast, blunted slender bodies exhibit much weaker effects of source flow on surface pressure wherever the blunt-nose effect dominates. Author

N63-23424 Brown Engineering Co., Huntsville, Ala.
A FORTRAN PROGRAM TO COMPUTE THE ANGLE-OF-ATTACK HISTORY OF A RE-ENTRY VEHICLE SUBJECTED TO AN EXTERNAL CONTROL MOMENT
J. A. Baird and B. H. Kavanaugh, Jr. Sept. 1963 88 p 5 refs
(Contract DA-01-009-ORD-1068)
(R-71)

This report describes a FORTRAN IV program which computes angle-of-attack histories of a nonspinning reentry vehicle subjected to nonlinear aerodynamic forces and an external control moment. The program is written for an IBM 7040 computer. Author

N63-23427 Air Force Systems Command, Eglin AFB, Fla.
FLIGHT TEST EVALUATION OF THE FLUSH-MOUNTED, TUMBLING-AIRFOIL, CRASH POSITION INDICATOR
V. L. Reierson Oct. 1963 21 p 5 refs
(ASD-TDR-63-46)

Test results are summarized as follows: (1) Marginal reception range was established at 56 nmi on one mission and good reception range at 40 nmi on two missions using SARAH receiving equipment. (2) The general reliability and ruggedness of the beacon to survive ejection and impact was adequately demonstrated during six ejections. (3) The following problem areas were observed: (a) inadvertent ejections of the beacon occurred twice, and were attributed to excessive sensitivity of ejection initiators; (b) failure of the crash position indicator to transmit occurred four times during this test; (c) fine tuning of the SARAH receiver was considered more difficult than necessary because of the short 3-sec "on" time, as compared to the long 5-sec "off" time. Flight tests of the beacon demonstrated the suitability of its employment after aircraft crash impact. Author

N63-23596 Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
PHOTOELASTIC DETERMINATION OF STRESSES DUE TO THE BENDING OF THIN CYLINDRICAL NOZZLES IN THIN SPHERICAL VESSELS
M. M. Leven Apr. 15, 1963 36 p
(Contract NObs-78182)
(Res. Rept. 63-917-514-R2)

The stresses on the inner and outer surfaces of thin cylindrical nozzles in thin spherical vessels were determined under the condition of pure bending of the nozzle. The photoelastic method of stress "freezing" and slicing was employed. In this method a plastic model is machined (generally from a solid casting) and subjected to constant loads, while the temperature is raised to its critical temperature and slowly cooled to room temperature. At room temperature the loads can be removed, but the strains are fixed or "frozen" into the model.

Careful cutting or sawing will not disturb these strains. It has been shown that these fixed or "frozen" strains represent those due to an elastic distribution of stress. Author

N63-23617 Army Missile Command, Huntsville, Ala.
A LEVELING SCHEME FOR AN INERTIAL PLATFORM UTILIZING A DIGITAL ACCELEROMETER
Keith Crozier and Herbert Mc Carley Sept. 20, 1963 18 p
(RG-TR-63-27)

The feasibility of using a pendulous integrating-gyro accelerometer with a digital encoder pickoff in a leveling scheme for an inertial platform is studied. A pendulum is suggested to partially level the platform; a precision servoloop utilizing a horizontal accelerometer will accurately level the platform. An analog computer simulation is made and conclusions drawn. Author

N63-23656 Illinois U., Urbana Engineering Experiment Station
AXIALLY SYMMETRIC AND ANNULAR SUPERSONIC NOZZLE PROFILES
W. L. Chow May 1963 104 p 5 refs
(NASA CR-52188; ME-TN-394-1) OTS: $9.10 ph, $3.32 mf

Axially symmetric and annular supersonic nozzle profiles, calculated on the basis of the Method of Characteristics, are compiled. For all the nozzles calculated, the solid-wall shape in the expansion region downstream of the throat has been selected to be parabolic, with the ratio of the radius of curvature at the throat and the radius of the nozzle at the throat to be ten. While axially symmetric nozzles were calculated for eight design Mach numbers, the annular nozzles were calculated for five design Mach numbers, with five values of the cylindrical-sting-to-throat radius ratio. C.L.W.

N63-23666 ARO, Inc., Arnold Air Force Station, Tenn.
TRANSFORMATION OF AXES SYSTEMS BY MATRIX METHODS AND APPLICATION TO WIND TUNNEL DATA REDUCTION
L. L. Trimmer and E. L. Clark (Tenn. Polytechnic Inst.) Oct. 1963 22 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-224)

A method is described which simplifies the derivation of many wind-tunnel data-reduction equations. Standard matrix techniques are used for the solution of the simultaneous equations encountered in the transformation of vector components from one axes system to another. Two typical applications are presented: the determination of aerodynamic angles, and the transfer of aerodynamic loads from body to wind axes. Author

N63-23668 Solar, San Diego, Calif.
DEVELOPMENT OF FRONTAL SECTION FOR SUPER-ORBITAL, LIFTING, RE-ENTRY VEHICLE [Fifth] Quarterly Progress Report
M. R. Licciardello, L. Fredlund, and B. Ohnysty Apr. 18, 1963 71 p refs
(Contract AF 33(616)-8497)
(ER-1115-21)

The ASSET frontal section configuration selected for operational environment tests consists of a heavy tungsten forging overlayed with 0.200-inch thoria which is reinforced with wire springs and tungsten wire mesh. The tungsten wire-mesh reinforcement was developed as a more reliable process than tungsten sine waves or vapor deposition as a means of reinforcing the thoria overlay. Physical properties of zirconia sol and nitrate bonded thoria were measured, and a nitrate bonded system was optimized for ASSET qualification. High-temperature exposure tests of various overlay systems were performed on subscale ASSET nose shapes. The nitrate bonded thoria formulation SO-71, fired at 2200° F and reinforced with tungsten wire mesh, was the superior composite system. Author

N63-23669 Solar, San Diego, Calif.
DEVELOPMENT OF FRONTAL SECTION FOR SUPER-ORBITAL, LIFTING, RE-ENTRY VEHICLE [Sixth] Quarterly Progress Report
M. R. Licciardello and B. Ohnysty Aug. 9, 1963 138 p refs
(Contract AF 33(616)-8497)
(ER-1115-25)

Design of the ASSET nose cap for ASV-4 was completed. Tests of two subscale and two full-scale nose caps were conducted in a plasma-arc tunnel. In addition, one full-scale cap successfully passed the load, vibration, and acoustic environment tests prior to the plasma-arc test. Thermodynamic and stress analyses were conducted on the cap indicating positive margins in all cases. Author

N63-23681 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DEVELOPMENT OF A SMOKE-TRAIL VEHICLE FOR APPLICATION TO WING-SHEAR MEASUREMENTS UP TO 80,000 FEET
Wade E. Lanford, Tom W. Perry, Jr., Hal T. Baber, Jr., and Franklin W. Booth Nov. 1963 26 p refs
(NASA TN D-2009) OTS: $0.75

A reliable, inexpensive, and relatively simple smoke-generating vehicle has been developed for extensive use at several missile ranges in a detailed wind-shear-measurement program. Details of the vehicle, which is capable of producing a luminiferous trail between the altitudes of 6,000 and 80,000 feet, are presented along with those of several other vehicles considered. Author

N63-23682 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN AEROELASTIC MODEL APPROACH FOR THE PREDICTION OF BUFFET BENDING LOADS ON LAUNCH VEHICLES
Robert V. Doggett, Jr., and Perry W. Hanson Washington, NASA, Oct. 1963 31 p refs
(NASA TN D-2022) OTS: $0.75

The relationships necessary for predicting full-scale buffet bending moments from wind-tunnel test data on dynamically scaled aeroelastic models are developed by using simple beam theory and generalized harmonic analysis. Wind-tunnel tests were made on two model configurations, each with a cylindrical afterbody. One had a blunted conical nose whereas the other had a bulbous nose. Some of the data obtained for the bulbous-nose configuration were scaled to full-scale values by using the derived scaling relationships. Author

N63-23684 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EFFECT OF CONTACT ANGLE AND TANK GEOMETRY ON THE CONFIGURATION OF THE LIQUID-VAPOR INTERFACE DURING WEIGHTLESSNESS
Donald A. Petrash, Ralph C. Nussle, and Edward W. Otto Washington, NASA, Oct. 1963 24 p refs
(NASA TN D-2075) OTS: $0.75

The results of this investigation with liquids that have contact angles of 0°, 40°, and 125° verified the contention that the contact angle remains unchanged from its 1-g value when the liquid is in a zero-g environment. In all tanks investigated

(spheres, cylinders, and cones), the liquid–vapor interface tended toward a configuration of constant surface curvature meeting the tank walls at the contact angle. Author

N63-23686 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REYNOLDS NUMBER EFFECTS ON THE INDUCED PRESSURES OF CYLINDRICAL BODIES WITH DIFFERENT NOSE SHAPES AND NOSE DRAG COEFFICIENTS IN HELIUM AT A MACH NUMBER OF 24
Richard D. Wagner, Jr., and Ralph Watson Washington, NASA, Nov. 1963 43 p refs
(NASA TR R-182)

Exact, inviscid pressure distributions and shock shapes, obtained by the method of characteristics, are compared with experimental data. The results indicate a strong dependence of induced pressures upon Reynolds number, especially in the region immediately downstream of the nose-cylinder junction. The measured shock shapes revealed no discernible effect of Reynolds number variations. Author

N63-23689 Stanford U., Calif.
A STUDY OF SUPERSONIC NONEQUILIBRIUM FLOW OVER A WEDGE
Richard S. Lee June 1963 81 p 13 refs
(Sponsored by NSF)
(SUDAER-160)

The study begins with a survey and discussion of the existing analytical work on the problem of supersonic nonequilibrium flow over a wedge and certain related topics. A new approach is then formulated that provides a more complete picture of the flow field and retains greater generality, especially in removing the restriction to a slender wedge. Both vibrational nonequilibrium and dissociation are treated in separate but parallel treatments. The uniform free stream may be either in equilibrium or frozen in some out-of-equilibrium state. Each exact problem is simplified systematically by assuming that the various unknown quantities deviate only slightly from their frozen-flow values. The resulting differential equations and boundary conditions are then solved. A simplified solution shows clearly the existence of a relaxation region behind the shock wave and an entropy layer next to the wedge surface, in addition to the classical incoming and outgoing waves along which disturbances are propagated. Author

N63-23709 Mc Gill U., Montreal (Canada)
RADIAL FLOW WITHOUT SWIRL BETWEEN PARALLEL DISCS HAVING BOTH SUPERSONIC AND SUBSONIC REGIONS
Paul S. Moller July 1963 40 p refs
(DRB Grant 9551-12)
(Rept. 63-10)

A theoretical and experimental study is made of turbulent radial flow between parallel discs with choked conditions at the channel inlet. Supersonic flow is found to exist for some distance downstream of the inlet to a point in the channel where a quasi-normal shock causes the flow to become subsonic. A numerical solution is obtained for the radial pressure distribution in the supersonic region assuming adiabatic flow with friction and area change. Agreement between experiment and theory is excellent when the skin friction is evaluated at the arithmetic mean between the one-dimensional static temperature and the wall temperature. With a square corner at the channel inlet, the choking mass flows were 15% less than those predicted for one-dimensional flow. By preceding the square inlet corner by a chamfered section, the mass-flows required to choke the flow approached the one-dimensional predictions. Author

N63-23722 Air Force Systems Command, Edwards AFB, Calif. Rocket Propulsion Lab.
VEHICLE SCALING AND PERFORMANCE COMPUTOR PROGRAM
R. N. James July 1963 162 p 5 refs
(RTD-TDR-63-1060)

This program provides a technique for weight scaling, dimensional scaling, and preliminary performance analysis of multistage liquid rocket vehicles with a minimum of input. The intention is to provide (1) an acceptable approximation for overall size and weight and not to attempt a component by component analysis, and (2) ideal velocity increment vs payload data rather than a detailed trajectory analysis. The equations used are presented, and a complete FORTRAN listing of the program written for an IBM 7094 is included. Author

N63-23736 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
ON THE AERODYNAMIC CHARACTERISTICS OF GRAPHITE PARTICLES
Z. R. Gorbis and R. A. Bakhtiozin May 23, 1963 9 p refs
Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy Energ. (Minsk), USSR, v. 11, 1961 p 101–104
(FTD-TT-63-393/1+2+4)

The limiting relative particle velocity of ten narrow fractions of artificial graphite particles was determined experimentally on two apparatus. An apparatus consisting of a conical glass tube with a particle elevation scale, sediment chamber, a blower, and an iris and measurement diaphragm was used to determine the average particle elevation, correction coefficient, and the suspending velocity by the formula $v_s = cv_0$. The second apparatus, which consisted of collectors with an inner sieve for supporting particle samples, cylindrical glass tubes, a common sediment chamber, a fine adjustment valve, a blower with an iris diaphragm, and a micromanometer, was used to experiment with varying masses of particles in different-sized tubes. The minimum velocity at which the finest component of a given fraction began to be carried off was determined, and with a consecutive increase in air velocity, the suspension of the remainder of the sample was determined. J.E.T.

N63-23744 Aeronautical Research Council (Gt. Brit.)
A NOTE ON THE GENERALISATION OF ELASTIC CURVES REPRESENTING PARACHUTE SHAPES
W. G. S. Lester 1963 33 p refs
(ARC-CP-665; supersedes RAE-TN-MECH-ENG-357; ARC-24396)
Available from HMSO: · 6s 6d

A concise treatment is given of the theory of parachute canopy shapes and stresses. An analysis is made of the equation

$$\sin\phi = \frac{1}{\lambda}\left[\lambda - 1 + \frac{r^2}{a^2}\right]$$

where r is the radial distance measured from the axis of symmetry and at its maximum value; ϕ is the angle the tangent to the curve makes with a plane normal to the axis of symmetry, and λ is a parameter. By varying λ, a family of elastic curves is generated representing the shapes of flat, conical, and annular parachutes, and also those with an axial cord. General equations for calculating the fabric surface area and canopy volume in the solid fabric construction are included, together with equations for determining the gore shapes for both the cords over canopy and solid fabric constructions. An approximate analysis is given of the stress distribution in the two constructions. Author

N63-23786 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPERSONIC INVESTIGATION OF NOZZLE HINGE MOMENTS OF A MODIFIED SATURN C-1 MODEL WITH AND WITHOUT JET FLOW
Nickolai Charczenko and Jerry L. Lowrey Washington, NASA, Nov. 1963 45 p refs
(NASA TN D-1962) OTS: $1.25

An investigation has been conducted in the Langley Unitary Plan wind tunnel to determine the nozzle hinge-moment coefficients for the Saturn C-1 vehicle with various shrouds at Mach numbers from 1.60 to 2.87. Nozzle hinge-moment coefficients were obtained from pressure measurements on one nozzle, with and without simulated jet flow. In addition, pressure measurements were obtained on one shroud and at the base of the model. A limited analysis of the results of this investigation indicates that the long shrouds result in small nozzle hinge-moment coefficients which are relatively independent of gimbal angle, Mach number, and jet flow. When the shrouds are shortened enough to allow significant impingement of the airstream on the nozzles, nozzle gimbal angle, Mach number, and jet flow become important factors in determining the magnitude of nozzle hinge-moment coefficients. Author

N63-23788 Michigan U., Ann Arbor Inst. of Science and Tech.
REPORT OF BAMIRAC: THE STRUCTURE OF THE ROCKET EXHAUST PLUME WITHOUT REACTION AT VARIOUS ALTITUDES
Thomas C. Adamson, Jr. June 1963 44 p refs
(ARPA SD-91; Proj. Defender)
(Rept. 4613-45-T)

A survey is made of the work done on the aerodynamic structure of the rocket exhaust plume. Reaction and mixing are not considered. Representative examples of various experimental techniques for studying jets are given. Analytical methods for predicting fine and gross structure are examined under three subheadings: linearized theories, method of characteristics, and approximate solutions. It is concluded that while the general features of the jet are well understood and evidently predictable, experimental verification at very high jet pressure ratios is desirable, as is further development of the easily applied approximate solutions. Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes: ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc.

For related information see: **02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.**

N63-23250 Aeronautical Research Council (Gt. Brit.)
WALL CORRECTIONS FOR WINGS OSCILLATING IN WIND TUNNELS OF CLOSED RECTANGULAR SECTION, PARTS I AND II
W. E. A. Acum (NPL) London, Min. of Aviation, 1963 77 p 4 refs
(ARC-R&M-3312; supersedes ARC-19593 and ARC-19756)
Available from HMSO: £1 10s

A method is described which derives the interference upwash due to an oscillating horseshoe vortex from that due to a steady one of the same shape. Applications to symmetrical or antisymmetrical lift distributions are discussed. The application of a delta wing in a 9 × 7 section tunnel is described and includes the effect of model size and frequency of oscillation. Author

N63-23317 Directorate of Aeromechanics, Aeronautical Systems Div., Wright-Patterson AFB, Ohio
SUPERSONIC PARACHUTE RESEARCH
Rudi J. Berndt and Charles A. Babish III *In* Aeron. Systems Div. Proc. of Retardation and Recovery Symp., Dayton, Nov. 13–14, 1962 p 112–157 refs (See N63-23314 24-01)

The background, experimental phases, and the results of two parallel investigations leading to the evolvement of flexible parachute canopy configurations for potential applications as first-stage aerodynamic deceleration devices at high supersonic velocities are presented. Generalized drag data and high-speed schlieren photographs, obtained during supersonic wind-tunnel tests on the most promising canopy configurations, are included to illustrate the performance characteristics of both supersonic aerodynamic decelerator concepts. Author

N63-23319 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLEXIBLE WING RESEARCH AND DEVELOPMENT
F. M. Rogallo *In* Aeron. Systems Div. Proc. of Retardation and Recovery Symp., Dayton, Nov. 13–14, 1962 p 195–213 refs (See N63-23314 24-01)

This paper reviews flexible-wing research and development projects recently completed or now in progress. Author

N63-23324 Minneapolis-Honeywell Regulator Co., Minn.
PARAVULCOON RECOVERY AND LANDING SYSTEM
A. J. Oberg, S. S. Sopczak, and M. A. Sutton *In* Aeron. Systems Div. Proc. of Retardation and Recovery Symp., Dayton, Nov. 13–14, 1962 p 368–416 refs (See N63-23314 24-01)

This paper presents the results of analyses and tests of a recovery and landing system combining the functional characteristics of a parachute and a hot gas balloon. The system components consist of a large nylon-mylar balloon which is ram air filled upon deployment by a pilot chute, a heat generator which warms the air within the balloon by convection, and a control system which modulates the heat generator to control the buoyant force. The forces of drag and buoyancy are used to decelerate a falling payload to a zero vertical velocity. To land the payload, the controlled buoyant force is decreased. Recovery and landing test data obtained from airdrops are presented along with laboratory test data. Consideration is also given for utilizing the PARAVULCOON system as a skyhook for exploration of Mars and Venus. Author

N63-23344 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
INVESTIGATION OF THE DYNAMIC LONGITUDINAL STABILITY OF DELTA-WINGED AIRCRAFT AT SUPERSONIC SPEEDS
C. M. Kalkman Feb. 25, 1963 61 p 14 refs
(NLR-TN-V.1913; supersedes NLL-TN-V.1846)

Dynamic stability calculations are carried out for delta-winged aircraft at supersonic speeds for different values of Mach number, flight altitude, sweep angle, center of gravity location, and wing loading. The results for periods and damping of the modes of motion are analyzed by means of approximated expressions. Author

N63-23392 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EFFECT OF ATMOSPHERIC TURBULENCE ON AN AIRPLANE WITH FLEXIBLE WINGS AT DIFFERENT SPEEDS OF FLIGHT
Yu. M. Romanovskiy and S. P. Strelkov Sept. 3, 1963 16 p 10 refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinost. (Moscow), no. 4, 1959, p 3-10
(FTD-TT-63-750/1+2)

A method is described for obtaining the statistical characteristics of forced vibrations of an elastic airplane wing under the action of atmospheric turbulence. This method permits the consideration of vibrations with different degrees of freedom. The increase in the number of degrees of freedom per unit leads to a two-unit increase in the order of the solvable system of algebraic equations. A comparison of the statistical characteristics of vibrations of one and the same model airplane shows that with sufficiently low frequencies of wing torsion, close to the critical rates for flutter, wing torsion should not be disregarded. Wing torsion must be considered in computing the joint bending-torsional vibrations of the wing. I.v.L.

04 AIRCRAFT

Includes: specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; stability and control.

For related information see: **02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.**

N63-23125 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
IN-FLIGHT SHOCK-WAVE PRESSURE MEASUREMENTS ABOVE AND BELOW A BOMBER AIRPLANE AT MACH NUMBERS FROM 1.42 TO 1.69
Domenic J. Maglieri, Virgil S. Ritchie, and John F. Bryant, Jr. Washington, NASA, Oct. 1963 48 p 18 refs
(NASA TN D-1968) OTS: $1.25

In-flight shock-wave pressure surveys have been made above and below a bomber airplane at distances of approximately 1,300 to 2,000 ft, and also below the bomber airplane at distances of about 4,600 to 9,100 ft. Measured pressure signatures are presented for the bomber airplane in the Mach number range from 1.42 to 1.69 with a gross-weight range from about 83,000 to 117,000 lb. A detailed description is given of the unique instrumentation probe used to obtain the pressure measurements along with the corresponding static and wind-tunnel calibrations. Author

N63-23135 David Taylor Model Basin, Washington, D.C. Aerodynamics Lab.
PRELIMINARY ANALYSIS OF HOVERING AND CRUISING PERFORMANCE FOR THE TRIDENT VTOL AIRCRAFT CONCEPT
Harvey R. Chaplin and Arnold W. Anderson Sept. 1963 59 p 7 refs
(DTMB-AERO-1058)

The Trident is a hypothetical tail-sitter with a tip-jet-driven 3-bladed rigid motor which becomes a trident wing with tip-propulsion jets upon transition to cruising flight. A key external- and internal-aerodynamic design problem is that of competing requirements for high static lift per horsepower in hovering, and efficient cruising performance. Equations applied to obtain performance estimates for nine configurations differing in rotor planform geometry are given. Results are confined to cold-jet cases. Author

N63-23138 Chance Vought Corp., Dallas, Tex. Aeronautics and Missiles Div.
TEST PROGRAM AND ANALYTICAL STUDY ON MODEL F-8 AIRPLANE MAIN LANDING GEAR LOADS Final Report
W. W. Kitts and J. Mollick May 31, 1963 194 p 4 refs
(Contract NOas 59-6231-f)
(Rept. 2-53470/3R100)

An experimental and an analytical program to determine and to compare the main landing-gear loads developed in airplane drop tests and in jig tests with and without forward speed has been conducted. The test data are summarized and compared to the analytical results. The derivation of the equations of motion used in the analyses is presented. Author

N63-23153 General Electric Co., Cincinnati, Ohio Advanced Engine and Technology Dept.
XV-5A LIFT FAN FLIGHT RESEARCH AIRCRAFT Quarterly Technical Progress Report No. 7, May 16, 1963-Aug. 15, 1963
Sept. 30, 1963 85 p
(Contract DA-44-177-TC-715)

Fit-up was begun between the propulsion system and airplanes, including resolution of minor installation problems. The test firings on the North American LW-2 ejection seat were successfully completed, including a through the XV-5A canopy ejection. Longitudinal and lateral-directional dynamic-stability analysis was up-dated, and indicates safe flight boundaries for all flight conditions. Six degree-of-freedom hover and transition simulation was completed, utilizing the flight-control system through the mechanical mixer box. Ejection-seat modification design and fabrication was completed for both ships. Number one aircraft successfully completed static structural test. Number two aircraft completed up to the point of propulsion-system fit-up. Author

N63-23168 Bendix Corp., Baltimore, Md. Friez Instrument Div.
CONTINUATION OF THE DEVELOPMENT OF THE AN/DMQ-9 ROCKETSONDE Final Report
K. W. Kidd Oct. 1963 41 p 4 refs
(Contract AF 19(628)-1655)
(AFCRL-63-841)

Included is a discussion of laboratory investigations of 1680 megacycle antennas, blocking oscillator circuits, and spin and acceleration effects on the instrument package. Flight test performance is presented. Author

N63-23182 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
PROJECT APEQS – SOLAR ECLIPSE
W. B. Klemperer and W. N. Arnquist Mar. 1963 35 p 1 ref
(SM-41833)

The Project APEQS report was prepared to document the technical aspects of equipping a commercial DC-8 aircraft as an airborne solar observatory to study the corona and chromosphere of the Sun during the total solar eclipse of July 20, 1963. The report describes the DC-8 aircraft, its equipment, its flight characteristics, its interior arrangement as a solar observatory, and special installations that are available to potential observers to facilitate their experimentation. Author

N63-23237 National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
THE X-15 PROGRAM
Joseph A. Walker and Joseph Weil *In* AIAA 2nd Manned Space Flight Meeting [1963] p 295–307 refs (See N63-23201 24-01)

The X-15 program is summarized in the following areas: (1) history of project—design development and flight tests; (2) operational experience—structural problems, thermostructural problems, rocket-engine experience, auxiliary-power-unit experience, and experience with control and guidance systems; (3) piloting aspects—boost, entry, and landing techniques; (4) future plans for the X-15—basic program and follow-on program. P.V.E.

N63-23322 American Power Jet Co., Ridgefield, N.J.
RELIABILITY OF RECOVERY SYSTEMS – EVALUATION AND ATTAINMENT
George Chernowitz *In* Aeron. Systems Div. Proc. of Retardation and Recovery Symp., Dayton, Nov. 13–14, 1962 p 280–315 refs (See N63-23314 24-01)

The factors which must be considered in evaluating the reliability of a proposed recovery system, and the appropriate mathematical methods and models for this purpose are discussed. Key points of engineering and critical components, as well as sources for reliability assessment, are covered. Additional topics include: component versus system reliability; the roles of design, checkout, and human factors; and the attainment and demonstration of reliability. Author

N63-23622 General Dynamics/Convair, San Diego, Calif.
GETOL RESEARCH PROGRAM Final Report
Ft. Eustis, Va., Army Transportation Res. Command., Aug. 1963 180 p refs
(Contract DA 44-177-TC-722)
(GDC-62-370; TRECOM-TR-63-1)

This report presents the results of an experimental research program to determine the aerodynamic characteristics of a ground-effect takeoff and landing (GETOL) aircraft, and to ascertain the feasibility and potential of a GETOL aircraft system. The objective of the GETOL concept is to produce an aircraft that would eliminate conventional landing gear and provide a capability for takeoff and landing over unprepared terrain. The program included static-room and wind-tunnel testing. Author

N63-23623 Bell Helicopter Co., Fort Worth, Tex.
HIGH-PERFORMANCE-HELICOPTER PROGRAM—PHASE I Summary Report, [Aug. 7, 1961–Jan. 1, 1963]
J. F. Van Wyckhouse and W. L. Cresap Ft. Eustis, Va., Army Transportation Res. Command Sept. 1963 86 p 12 refs
(Contract DA 44-177-TC-711)
(Bell Rept. 533-099-005; TRECOM-TR-63-42)

The results of a flight research program with a helicopter which was modified into a high-performance configuration are presented. The helicopter modifications are described and include external fairings, a tilting pylon system, and a new three-bladed rotor system. The performance, structural loads, and vibrations for the test vehicle with the two-bladed-rotor and with the three-bladed-rotor system, in both rigid and gimbaled configurations, are discussed and compared with those of the UH-1B. Theoretical predictions from an earlier analytical study program are shown for comparison. It is shown that the performance of the test vehicle is significantly improved, and that there is a corresponding reduction in structural loads and vibration. Author

N63-23699 Army Missile Command, Huntsville, Ala. Test and Evaluation Lab.
TRANSPORTATION-VIBRATION TEST OF PERSHING MISSILE SYSTEM TACTICAL SHIPPING AND STORAGE CONTAINERS– PHASE I Final Report
Ronald G. Eyestone Oct. 2, 1963 60 p
(RT-TR-63-6)

This test subjected tactical containers for the PERSHING missile system, and their dummy loads, to the vibration spectrum expected during truck transportation. Author

N63-23720 Aerospace Corp., El Segundo, Calif.
NOTES ON THE DIFFRACTION OF BLASTS BY FLYING VEHICLES. PART I: GENERAL COMMENTS. PART II: BLAST-WAVE, MACH-WAVE INTERACTION
J. W. Miles Aug. 26, 1963 26 p refs
(Contract AF 04(695)-269)
(TDR-269(4230-30)-1; SSD-TDR-63-195)

Whitham's technique for the approximate calculation of the diffraction of shock waves by stationary bodies is applied to the diffraction of a blast wave by a Mach wave that emanates from the apex of a thin wedge in supersonic flight. The approximate results tend to the exact results for weak blast waves, but are unsatisfactory for very strong blast waves. Author

N63-23770 General Dynamics/Convair, San Diego, Calif.
STABILITY ANALYSIS – LITTLE JOE II
F. D. Steketee July 23, 1963 34 p
(DC-12-011)

The gain margins agree with those developed from analog computer simulation, and the phase margin exceeded 27° for all conditions analyzed in this study. Hysteresis, or bearing slop, between the actuator and surface can cause a limit cycle, or buzz, through a portion of the trajectory. For a maximum tolerance slop in the bearings, this will cause a hydraulic fluid usage equivalent to 37 degrees of surface travel. Hysteresis in the servovalve can also cause a limit cycle. For a maximum tolerance condition, this could cause a hydraulic fluid usage equivalent to approximately 10 degrees of surface travel. These limit cycles are of a low magnitude and will not adversely effect the trajectory or on-board equipment. The exoatmospheric response of the vehicle was evaluated to assure that the body bending mode does not couple into the reaction control system. Author

N63-23776 Aeronautical Research Council (Gt. Brit.)
FLIGHT TESTS OF A HOVERING JET-LIFT AIRCRAFT (ROLLS-ROYCE FLYING BEDSTEAD)
J. K. B. Illingworth London, HMSO, May 1961 14 p 3 refs
(ARC-R & M-3336; previously issued as RAE-AERO-2651; ARC 23219) Available from HMSO: 10s 6d

This report describes the flight tests on the Rolls-Royce Flying Bedstead to investigate the stability and control problems of a hovering jet-lift aircraft. Tests made with varying amounts of artificial stabilization (including a few without stabilization) showed that some artificial stabilization was necessary in pitch and roll for operation in other than very favorable weather conditions. Yaw stabilization was not essential for hovering flight. Author

N63-23787 Stevens Inst. of Tech., Hoboken, N.J. Davidson Lab.
HYDROFOIL IN HEAD SEAS
Charles J. Henry and M. Raihan Ali Oct. 1963 35 p 9 refs
(Contract Nonr 263(45))
(R 982)

The results of the present investigation show that the measured lift response of finite aspect ratio hydrofoils in regular head seas is linearly related to the measured wave input. Thus, spectral theory can be used with gust response operators as well as wave height spectra to predict the statistical character of the unsteady lift on finite aspect ratio hydrofoils in irregular head seas. Using the measured gust response operators from regular head sea tests for two hydrofoils with aspect ratios 2 and 4, the computed lift spectra were found to be in good agreement with the measured lift spectra. Author

05 ASTRONOMY AND ASTROPHYSICS

Includes: celestial mechanics; and radioastronomy.

For related information see: 12 Geophysics; and 29 Space Sciences.

N63-23021 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

THEORY OF ORBIT DETERMINATION – PART I CLASSICAL METHODS

John D. Anderson Oct. 1, 1963 10 p 5 refs

(NASA Contract NAS7-100)

(NASA CR-52021; JPL-TR-32-497) OTS: $1.10 ph, $0.80 mf

A cursory review of the classical methods of orbit determination is given for the purpose of orienting the reader to the nature of the classical orbit determination problem. The Gaussian and Laplacian methods of obtaining a first approximation to the orbit are outlined. A list of references is included that provides exhaustive treatments of the classical orbit determination topics. Author

N63-23022 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

IONOSPHERIC ABSORPTION OF EXTRATERRESTRIAL RADIO WAVES

Larry W. Brown Oct. 1962 76 p 37 refs

(NASA TM X-50841; I-615-62-194) OTS: $7.60 ph, $2.48 mf

The absorption is shown to be an integration of the real part of the complex ionospheric conductivity over the ray path. A model ionosphere is constructed from recent rocket and satellite observations. This model shows that under equilibrium conditions only electron interactions with ions and collisions with neutral nitrogen and oxygen molecules contribute significantly to the absorption. A separate calculation of the absorption due to electron–neutral collisions, and that due to electron–ion interactions shows that each phenomenon occurs in a distinctive region of the ionosphere. Although the absorption takes place in different parts of the ionosphere, no quantitative method of separation is found. The principle of riometer measurements of extraterrestrial radio noise is reexamined in order to determine the precautions necessary to ensure that only the cosmic noise power with absorption is measured. Methods are presented for reduction of the riometer records in terms of the absorption experienced by the radio waves at particular times. Author

N63-23120 Centro di Studio per la Fisica delle Microonde, Florence (Italy)

RADAR-ECHO RATE FROM SHOWER METEORS. PART II: RANGE DISTRIBUTION Technical Note No. 5

A. Consortini and M. E. de Langer July 1963 19 p 13 refs

(Contract AF 61(052)-592)

(AFCRL-63-733)

The theoretical range distributions of the meteor echoes due to Perseid's shower are calculated for four sets of values of the parameters and compared in order to establish the influences yielded by a variation of these parameters in the final results. A rough comparison is also done between theoretical and experimental range distributions to determine the theoretical range distribution which better fits the experimental data. Author

N63-23164 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ORIGIN OF TEKTITES

J. A. O'Keefe and B. E. Shute Washington, NASA Repr. from Science, v. 139, no. 3561, Mar. 29, 1963 p 1288–1290 20 refs

(NASA RP-113)

It is shown, from aerodynamic theory, from observations of distribution around terrestrial impact craters, and from experimental nuclear explosions, that the observed distribution of tektites cannot be the result of impact on the earth, whether cometary or meteoritic. It is further shown, from aerodynamic theory, from observation of a meteor shower, and from study of the breakup of artificial satellites, that the distribution of tektites can be accounted for as a result of fusion stripping of a satellite. Author

N63-23303 Air Force Cambridge Research Labs., Bedford, Mass.

A REVIEW OF THE MOON'S ROTATION AND MECHANICAL FIGURE FROM HELIOMETER OBSERVATIONS

Mahlon S. Hunt and Donald H. Eckhardt (Arizona U.) *In its* Compendium of Papers in the Fields of Geodesy and Planetary Geometry Aug. 1963 19 p refs Presented at the RAND Corp. Symp. on Solar System Constants, Santa Monica, Feb. 22–26, 1962 (See N63-23301 24-01)

The classical methods of heliometric data reduction are deficient from several aspects. Efforts have been made to resolve inadequacies in the classical reductions, and to combine available heliometric observational series into a unified reduction with the aid of electronic computers. Author

N63-23304 Air Force Cambridge Research Labs., Bedford, Mass.

LARGOS: A SUGGESTED METHOD FOR STEREO-TRIANGULATION

Michael S. Tavenner *In its* Compendium of Papers in the Fields of Geodesy and Planetary Geometry Aug. 1963 9 p refs Presented at the 43rd Ann. Meeting, Amer. Geophys. Union, Washington, Apr. 1962 (See N63-23301 24-01)

Lasers, located at each ground observing station, beam light pulses activated by a common triggering circuit to the satellite. The satellite reflects each signal to its respective source where the signal is recorded on a photographic plate against a background of stars. Reduction of these photographic plates gives extremely accurate information as to satellite and/or ground station position. Advantages of LARGOS are: (1) All complicated equipment is on the ground where it may be repaired or adjusted; (2) by keeping prismatic reflectors small, weight is held to a minimum; (3) power requirements for the source are small ($\simeq 10^3$ watt seconds); (4) the system is adaptable for tracking any satellite or missile. Author

N63-23340 Tokyo Astronomical Observatory (Japan)

OCCULTATION OBSERVATIONS IN JAPAN DURING 1955

Y. Endo May 25, 1963 17 p

(*Its* Astron. Bull. 2nd ser. no. 159; Cont. from T.A.B. II, no. 91)

Reductions of occultation observations in Japan during 1955, computed in terms of Ephemeris time, are tabulated giving the coordinates of observers and the results of the reductions. M.P.G.

N63-23357 Aerojet-General Corp., Azusa, Calif. Computing Sciences Div.
KEPLERIAN TABLES FOR CONIC ORBITS
F. H. Brady Feb. 1963 130 p 7 refs

Tables of solutions to the various forms of Kepler's equation for conic orbits arising from the central force two-body problem are presented for the use of space scientists who must deal with these types of orbital motions without the aid of automatic computing equipment. The tables presented provide the equivalent true anomaly directly as a function of eccentricity and parabolic mean anomaly, thus bypassing the need for eccentric anomaly or its hyperbolic equivalent. Examples demonstrating the use of the tables are given, and astronomical data is appended to provide a comparison of solar system central force sources. M.P.G.

N63-23451 National Academy of Sciences, Washington, D.C. Space Science Board
ASTRONOMY IN THE SPACE AGE
Edward R. Dyer, Jr. *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 253–267 (See N63-23436 24-01)

Two competing present day cosmological theories are outlined to give an example of the nature and scope of the problems being considered by astronomers in the space age. The relativistic theory that the universe at large is evolving with time is contrasted with the steady-state theory that new matter is continuously created at such a rate as would keep the average density of matter in space constant in the course of time. Since the light from a distant galaxy may take a billion years to reach the earth, a means exists to observe events that occurred a billion years ago and thus resolve the questions posed by the various cosmologies. The usefulness of observations from above the earth's atmosphere made with highly sophisticated equipment in determining the temperatures and elemental abundances of stars and the amount of matter in interstellar space is discussed. The application and significance of ultraviolet, infrared, and radio techniques to astronomy are indicated. It is concluded that astronomy is about to undergo an observational revolution provided by the technology of the space age and a theoretical revolution which will either explain the universe on evolutionary grounds or demand a complete revision of fundamental physical theory. M.P.G.

N63-23631 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INTERFERENCES DURING PHOTOELECTRIC OBSERVATIONS OF METEORS
D. L. Astavin-Razumin Nov. 29, 1962 8 p 3 refs Transl. into ENGLISH from Byull. Vsesoyuz. Astronomo-Geodezicheskoye Obshestvo (Moscow), no. 28(35), 1960 p 6–10
(FTD-TT-62-1428/1+2)

The main interferences during photoelectric observation of meteors are divided into two groups. The first group includes outer interferences—level of luminosity of the nocturnal astral sky, flickering of stars and terrestrial sources of light, electrical interferences from low-frequency currents, etc. The second group includes internal interferences that arise from the electric fluctuations in photomultipliers and tube amplifiers. The problem of determining luminous intensity of meteors by the photoelectric method is shown to be much more difficult than the analogous problem in astral astronomy. R.T.K.

N63-23632 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE THRESHOLD OF OTHER WORLDS
L. Ksanformaliti Jan. 3, 1963 12 p Transl. into ENGLISH from Radio (Moscow), no. 3, 1963 p 10–12
(FTD-TT-62-1465/1+2+4)

The interrelationship of the sciences of radio engineering and astronomy, and the contributions of the disciplines to each other is discussed. There is as much electronics as optics in the new large telescopes. An automatic electronic polarimeter has been developed. The most widespread form of detector used in astronomy is the photoelectric multiplier. A photoguide, a device for the automatic tracking of a star by telescope, has been designed; and the thermoelement and bolometer are indispensable instruments in astronomy. Perfection of electronic devices has led to multistage image-converter tubes, and television astronomical systems have come into use. R.T.K.

N63-23725 Air Force Systems Command Wright-Patterson AFB, Ohio Foreign Tech. Div.
NEW PRISM (ATTACHMENT) TO A THEODOLITE TELESCOPE FOR AIMING AT THE CENTER OF THE SOLAR DISK
Waclaw Gradzki Nov. 27, 1962 15 p Transl. into ENGLISH from Przeglad Geodezyjny (Poland) v. 32, no. 8, 1960 p 281–286
(FTD-TT-62-1090/1+2)

Higher aiming accuracy is obtained with a new construction of an attachment in the form of a square-shaped pyramid with four prisms with strictly symmetrical arrangement of optical errors in the field of vision of a telescope. In this system, the optical errors of the four pictures of the solar disk are identical, whereas in the system it has replaced they are not. A comparison of the two systems is presented. J.E.T.

06 AUXILIARY SYSTEMS

Includes: fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters.

For primary propulsion systems see: 27 Propulsion

For related information see: 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; and 22 Navigation and Guidance.

N63-23034 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ENVIRONMENTAL TEST PROGRAM AND SYSTEMS EVALUATION OF THE S-3 ENERGETIC PARTICLES SATELLITE
Frank A. Carr Jan. 21, 1963 277 p 7 refs
(NASA TM X-50853; NASA X-326-63-10) OTS: $17.50 ph, $8.51 mf

The primary objective of the S-3 Satellite was to describe completely the trapped corpuscular radiation, solar particles, cosmic radiation, the solar winds, and to correlate particle phenomena with magnetic field observations. This report describes the test program, the test results, an evaluation of each spacecraft system, and presents conclusions and recommendations intended to initiate improvements in future spacecraft and their test programs. Author

N63-23044 Vickers Inc., Detroit, Mich. Machinery Hydraulic Div.
CONCEPTUAL STUDY OF EQUIPMENT AND HARDWARE TO PROVIDE RANDOM MOTION OF VEHICLE SIMULATORS

G. Mc Connell and D. Ruger Mar. 15, 1963 112 p
(NASA CR-51737) OTS: $9.60 ph, $3.56 mf

Both conventional and energy-storage hydraulic control systems for a vibration generator were studied in detail and compared as to cost, performance, accuracy, probability of success, and ease of changing frequency and amplitude. The conventional control system is a servovalve-cylinder positioning system with pressure demand. Two types of energy storage systems were analyzed both of which involve the use of resonance phenomena. One system uses mechanical springs for energy storage, and the second system utilizes fluid compression as a means of energy storage. I.v.L.

N63-23325 Northrop Corp., Ventura, Calif.
SYSTEMS CONSIDERATIONS
Theodore W. Knacke *In* Aeron. Systems Div. Proc. of Retardation and Recovery Symp., Dayton, Nov. 13–14, 1962 p 418–441 refs (See N63-23314 24-01)

Parachutes today form a subsystem part of the total recovery system. Requirements for reliability have been increased by an order of magnitude. New methods are being developed for force determination. Sequencing and reliability of the recovery cycle are an important factor. New approaches are desirable for location aids. Self-inflating flotation bags have recently been developed and used successfully. Author

N63-23370 Radio Corp. of America, Burlington, Mass. Aerospace Communications and Controls Div.
PROGRAM 706, TASK 3. LINEAR SHAPED CHARGE SEPARATION TESTS Second Quarterly Progress Report
S. J. Engel, and R. R. Batchelder July 20, 1963 52 p 3 refs
(Contract AF 04(695)-273)
(SSD-TDR-63-183-(III))

A report of the study and laboratory test of a flexible linear-shaped charge (FLSC) system for space-vehicle stage separation is presented. Three separation tests that were performed using a P706 interstage are described, including preliminary results of these tests. The success of the tests demonstrates that the separation system design is functionally acceptable. The magnitude of the measured shock response decreased with distance from the separation plane. Minimum correlation was obtained from gross impulse calculations, as expected. X-ray photography of the shaped charge proved useful. Author

N63-23384 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
LIMITING LAW FOR RELIABILITY OF SEQUENTIAL SYSTEMS
B. G. Klimov Aug. 16, 1963 18 p 2 refs Transl. into ENGLISH from Vychisliter'naya Tekhn. (Moscow), no. 4, 1962 p 98–110
(FTD-TT-63-470/1+2+4)

This article demonstrates that the exponential law of reliability is an intrinsic property of practical systems consisting of a large number of elements, regardless of the distribution of their intervals of trouble-free operation. A limiting law for the reliability of sequential systems is formulated, and consequently this method of calculating the reliability of complex sequential systems based on the summation of the characteristics of the elements is given a stricter theoretical basis. C.L.W.

N63-23396 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
APPROXIMATE METHODS FOR ANALYZING NON-LINEAR AUTOMATIC SYSTEMS [PRIBLIZHENNYE METODY ISSLEDOVANIYA NELINEYNYKH AVTOMATICHESKIKH SISTEM]
Ye. P. Popov and N. P. Pal'tov Jan. 24, 1963 990 p 348 refs Transl. into ENGLISH
(FTD-TT-62-910/1+2)

An attempt is made to give an account of the approximate methods which are simplest and easiest in practical application for the investigation and design of a definite class of nonlinear automatic systems, and are suitable for the solution of certain synthesis problems for such systems. The initial theoretical basis of these methods is formed by the ideas of harmonic balance and equivalent linearization propounded in the works of Krylov, Bogolyubov, and Bulgakov. The different methods proposed for the solution of the diverse nonlinear problems that arise from practical requirements and which are reduced to concrete applications, are unified by the general idea of harmonic linearization of nonlinearities in its different forms, invoking finally the statistical linearization proposed by I. Ye. Kazakov. C.L.W.

N63-23592 North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
THE TECHNIQUES OF RADIOGRAPHIC INSPECTION, A LITERATURE SURVEY [1950–1963]
L. G. Lubin Sept. 11, 1963 54 p refs
(SID-63-1186)

This bibliography includes information on the fundamentals of radiographic inspection, and details on its various applications and techniques used in the nondestructive testing of materials in industry. Bibliographic references include literature in foreign languages as well as in English. Author

N63-23649 California U., Berkeley Space Sciences Lab.
DYNAMIC ANALYSIS OF A ONE DIMENSIONAL POROUS ELECTRODE MODEL Technical Report
Edward A. Grens II (Ph.D. Thesis) Sept. 1963 226 p 40 refs
(NASA Grant NsG-150-61)
(NASA CR-52185; *Its* Ser. 4, Issue 55) OTS: $15.00 ph, $6.98 mf

A one-dimensional model is developed to represent flooded porous electrodes in which there is no bulk flow of electrolyte in the pores. In this representation, the pore configuration is ignored and the entire electrode treated as a homogeneous macroscopic region of electrolyte with distributed current and species sources. Analysis of the model is conducted by numerical techniques to furnish descriptions of electrode behavior for both steady state and transient operation. Performance characterization includes electrode overpotential and current and concentration distributions as functions of current drain and system parameters. The computational procedure is implemented on digital computing machinery. Examples based on the cadmium anode in 5N KOH and on the ferri-ferrocyanide electrode in 2N NaOH are investigated. Author

N63-23702 General Motors Corp., Anderson, Ind.
SILVER-ZINC SECONDARY BATTERY INVESTIGATION Technical Documentary Report [July 1962–Aug. 1963]
J. J. Lander and J. A. Keralla Wright-Patterson AFB, Ohio, AF Aero-Propulsion Lab., Oct. 31, 1963 83 p
(Contract AF 33(657)-8943)
(RTD-TDR-63-4029)

One-percent palladium added to the silver positive plate appreciably increases cycle life, maintains the monovalent charge capacity for 500 to 1000 cycles, and tends to reduce silver migration through separators. Silver particle sizes studied in the micron range of > 1 to 12 do not appreciably affect voltage, capacity, or cycle life of silver plates. The use of polyvinyl alcohol as a binder material in the negative active material increases negative plate life. Increasing Hg content of the

negative plate active material and increasing KOH concentration both result in marked reduction in rates of hydrogen generation on stand in the temperature range 75° to 125° F. Increasing HgO content results in decreased cycle life. Two batteries containing 1%-palladium coated silver were cycle life tested. One achieved 633 cycles at 25% depth of discharge; the other achieved 268 cycles at 40% depth of discharge. Author

N63-23703 Electro-Optical Systems, Inc., Pasadena, Calif.
STUDY OF DATA TRANSMISSION SYSTEMS FOR A SPACE SIMULATION CHAMBER – DESIGN AND TEST OF AN ENGINEERING MODEL
D. W. Mc Dowell and A. Schaffer Arnold Air Force Station, Tenn., Arnold Eng. Develop. Center, Oct. 1963 81 p 1 ref
(Contract AF 40(600)-947)
(AEDC-TDR-63-231)

This document describes an engineering prototype of a data transmission system for a space simulation chamber. Data inputs were simulated and compared with the corresponding outputs. Design data and test results are given. The engineering model consists of a pulse-amplitude-modulated FM microwave transmitter with the associated modulator, receiver, power supplies, and accessory test equipment required to test the design concepts. A microwave rotary joint was included in the system to evaluate this method of data transmission from a gimbal mounted vehicle. Author

N63-23760 Bureau of Mines Pittsburgh, Pa.
SENSITIVITY CHARACTERISTICS OF LIQUID EXPLOSIVE SYSTEMS Progress Report No. 7, July 1–Sept. 30, 1963
Charles M. Mason, John Ribovich, and Milton L. Weiss Oct. 1963 9 p refs
(BuWeps Order IPR-19-63-8029-WEPS)

The evaluation of the shock sensitivity of liquid explosives was continued with 50-50 nitroglycerin–ethyleneglycol dinitrate (NG–EGDN), Metriol trinitrate (TMETM), and nitromethane. With the NG–EGDN system, the gap thicknesses at which 50 percent of the trials gave high-velocity detonations and 50 percent gave low-velocity reactions were determined in various containers to improve the approximate values reported earlier. Metriol trinitrate was observed to be slightly less sensitive to shock initiation than NG–EGDN, but to yield both low- and high-velocity detonations. In the projectile impact test, NG–EGDN was observed to be initiated into a low-velocity reaction with a shock pressure of approximately 3 kilobars. Author

N63-23802 Minneapolis-Honeywell Regulator Co., Minn.
AN APPLICATION OF TIME OPTIMAL CONTROL TO A FLEXIBLE LAUNCH VEHICLE
J. A. Lovingood and F. B. Smith, Jr. [1962] 32 p refs
(NASA Contract NASr-27)
(NASA CR 52287) OTS: $3.60 ph, $1.16 mf

A minimum response time criterion is used in the design of a pitch attitude controller for a flexible launch vehicle. The criterion is applied to a fourth-order model containing the primary dynamics of an assumed thirteenth-order vehicle. A collection of time-optimal open-loop trajectories is used to define the closed-loop control law. Results of an analog simulation are presented which show that this control law properly applied to the flexible vehicle results in good control. Author

07 CHEMISTRY

Includes: chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis.

For related information see: **18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.**

N63-23011 Shell Development Co., Emeryville, Calif.
DEVELOPMENT OF ANALYTICAL TECHNIQUES FOR HYDROCARBONS IN MINERAL AGGREGATES Final Report, July 1962–June 1963
D. P. Stevenson and A. G. Polgar [1963] 45 p refs
(NASA Contract NASw-438)
(NASA CR-51999; S-13893) OTS: $4.60 ph, $1.55 mf

There is described an extraction-elution chromatography procedure for the recovery of representative samples of small quantities of saturated hydrocarbons of molecular weight greater than ca 200 from mineral aggregates such as sedimentary rocks. Provided the concentration of sought hydrocarbons in the rock C (ppm) exceeds 1 ppm, and the product $CW \geq 500$, where W is the weight of rock sample in grams, the recovery procedure leads to representative samples suitable for characterization by mass, infrared, and/or ultraviolet spectroscopy. It is found that for small samples, 0.1 to 1.0 mg, of complex, saturated hydrocarbon mixtures, the accuracy of mass spectrometric characterization is such that the relative concentrations of adjacent homologs are determined to $\pm 10\%$. Author

N63-23045 Hughes Aircraft Co., Culver City, Calif.
DEVELOPMENT OF ORGANIC SEALANTS FOR APPLICATIONS AT VERY LOW TEMPERATURES Final Report, July 1, 1961–June 30, 1962
I. M. Zelman, R. I. Akawie, and C. J. Bahun June 30, 1962 79 p 42 refs
(NASA Contract NAS8-2428)
(NASA CR-51727; Rept. P 62-29) OTS: $7.60 ph, $2.57 mf

The most promising materials, Adiprene L-100, cured with castor oil, and a silicone sealant XE-1027 were modified to increase their ability to withstand stresses at liquid nitrogen temperature. Further evaluation studies indicated that the Adiprene formulation reinforced with glass fabric resists thermal shock, bending and vibration loads at 76° K, and has a coefficient of thermal contraction approximately equal to that of aluminum. Silicone polymers were synthesized that may serve as bases for sealants having improved low-temperature flexibility. A fixture was designed and used for the testing of sealants vibrated at cryogenic temperatures. A sealant was formulated and evaluated for the sealing of crevices in cryogenic propellant dome tanks. A literature survey is included in the report. Author

N63-23064 Wisconsin U., Madison
SPECTROSCOPIC STUDIES OF LIGHT ELEMENT COMPOUNDS Quarterly Status Report No. 16, Apr. 1–June 30, 1963
Paul Bender and Monroe V. Evans Aug. 21, 1963 4 p
(Contract DA-11-022-ORD-3129)

Spectroscopic studies are summarized in the following research areas: (1) high-temperature Raman spectroscopy; the Raman intensity of the first overtone transition for chlorine was found to be markedly lower than would be predicted on the basis of mechanical anharmonicity alone; (2) infrared

spectroscopy; a computer program for the automatic construction and symmetrization of the "G" matrix required for normal coordinate analysis of vibrational spectra has been written, run, and hand checked. P.V.E.

N63-23067 IIT Research Inst., Chicago, Ill. Technology Center
OPTICAL SPECTRA OF SOME LOW-MOLECULAR-WEIGHT COMPOUNDS USING THE MATRIX-ISOLATION TECHNIQUE Quarterly Technical Summary Report, May 14–Aug. 14, 1963
Alan Snelson [1963] 4 p 1 ref
(Contract DA-31-124-ARO(D)-111; ARPA Order 458)
(IITRI-C6013-1)

Progress reported includes: (1) A molecular-beam furnace and a matrix-isolation cryostat were constructed and tested. (2) A simple inert-gas collection and storage system was designed. All the gases are passed through activated charcoal, which is maintained at dry ice–acetone temperature to remove any adsorbable impurities. (3) Suitable experimental conditions were established for the vaporization of the following compounds: aluminum fluoride, lithium–aluminum fluoride, lithium fluoride, beryllium fluoride, lithium–beryllium fluoride, and lithium metaborate. (4) A Perkins–Elmer 521 infrared spectrometer was delivered, and arrangements have been made to obtain a supply of liquid helium. I.v.L.

N63-23078 Franklin Inst., Philadelphia, Pa. Labs. for Research and Development
DIFFUSION IN ORGANIC CRYSTALS Quarterly Technical Report, June 27-Sept. 30, 1963
C. H. Lee, P. J. Reucroft, and M. M. Labes [1963] 5 p
(Contract DA-31-124-ARO(D)-142; ARPA Order 462)
(B2130-T-1)

Self-diffusion in C-14 anthracene single crystals will be investigated by means of a radioactive tracer technique. After diffusion anneal, the specimen will be mounted on a brass block by means of a low melting point wax for microtome sectioning. The brass block will be prepared with a ground flat surface. This brass block also serves as a holder for grinding off the peripheral surface of the specimen for eliminating the effect due to surface diffusion. The radioactivity of each section is to be measured by means of a Tri-carb Liquid Scintillation Spectrometer. This method has the advantage of avoiding geometric effects. I.v.L.

N63-23097 Avco-Everett Research Lab., Everett, Mass.
ESTIMATION OF THREE BODY RECOMBINATION RATE CONSTANTS
Benjamin J. Woznick and James C. Keck Aug. 1963 11 p 16 refs
(Contracts AF 04(694)-33 and DA-19-020-AMC-0210; Proj. Defender)
(AMP 119; BSD-TDR-63-184)

Curves useful in the estimation of rate constants by the variational theory are presented. The comparison of theoretical and experimental results is brought up to date. Author

N63-23098 Oak Ridge National Lab., Tenn.
TRANSURANIUM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING FEBRUARY 28, 1963
W. D. Burch, comp. Oct. 8, 1963 67 p refs
(Contract W-7405-eng-26)
(ORNL-3482) OTS: $1.75

Progress is discussed in the development of separation processes for the transuranium elements, process-equipment development, high-flux isotope reactor target-fabrication development, design of the transuranium processing facility, design of development facilities, corrosion studies, and analytical research and development studies. P.V.E.

N63-23115 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
THE SURFACE CHEMISTRY OF HMX
J. Haberman and T. C. Castorina Oct. 1963 29 p 18 refs
(PA-TR-3089)

The solution adsorption properties of HMX were studied using a carbon-14 labeled quaternary ammonium salt, stearyltrimethyl ammonium bromide (STAB). A solvent system consisting of 10% ethanol and 90% water gave acceptable isotherms on 10-micron HMX. Calculations based on the assumed surface area of an average size particle show that the amount of STAB actually adsorbed is about half or less of the amount that would be adsorbed in a close-packed monolayer. This is indicative of the low surface energy of HMX. Desorption experiments show that the absorption of STAB on HMX is reversible and hence physical in nature. Author

N63-23141 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF INTERMOLECULAR ELECTRON TRANSFER IN TETRAPYRROLE PIGMENTS DURING PULSED ILLUMINATION
P. A. Shakhverdov and A. N. Terenin Oct. 21, 1963 8 p 11 refs Transl. into ENGLISH from Doklady Akad. Nauk SSSR (Moscow), v. 150, no. 6, 1963 p 1311–1314
(JPRS-21519; OTS-63-31971) OTS: $0.50

In studying the effects of powerful pulsed illumination on tetrapyrrole pigments of the type of porphyrine, chlorophyll, and phthalocyanine in solution, an attempt is made to distinguish the transfer of a hydrogen atom from the transfer of an electron in a primary photoreduction reaction. Phenol, diphenylamine, triphenylamine, and benzidine are used as the reducing agents, and magnesium phthalocyanine and hematoporphyrin were used as the pigments. C.L.W.

N63-23147 Atomic Energy Commission, Bombay (India)
RECOIL EFFECTS OF COBALT-58 RESULTING FROM (γ,n) REACTION IN COBALT COMPLEXES
Amar Nath and An. N. Nesmeyanov 1963 25 p 43 refs
(AEET-CD-14)

The recoil effects of Co^{58} resulting from Co^{58} (γ,n) Co^{58} reaction, were studied in several cobalt chelates. The pattern of thermal annealing in (γ,n) reactions was found to be very similar to that obtained for (n,γ) reactions, despite the very large difference in recoil energies. The experimental data have been examined in the light of existing models and concepts, and the authors have proposed a model for stabilization of the recoil atom in the form of metastable species, which possess well-defined configurational and/or electronic defects. Author

N63-23382 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
METHOD OF OBTAINING PERFLUODICARBONIC ACIDS
I. L. Knunyants, V. V. Shokina and Li Chu Yuan May 22, 1963 4 p Transl. into ENGLISH from Russian Patent 127654, (Appl. 630762/23, June 12, 1959), 1960 p 1–2
(FTD-TT-63-457/1)

A method of obtaining perfluodicarbonic acids by means of oxidation of perfluorolefins by permanganate of potassium is described. The method is distinguished by the fact that in

order to obtain acids of the general formula $HOOC(CF_2)_{4_1}$ + $_4COOH$.$\alpha\omega$-perfluodiolefin with the number of carbon atoms equal to or greater than eight and multiples of four is subjected to oxidation. P.V.E.

N63-23397 Gt. Brit. Ministry of Aviation, Mottingham Technical Information and Library Services
PREPARATION AND PROPERTIES OF SOME PURE POLYETHYLENE GLYCOLS AND OF THEIR NITRATES [PREPARATION ET PROPRIETES DE QUELQUES POLYETHYLENE-GLYCOLS PURS ET DE LEURS NITRATES]
P. Aubertein Sept. 1963 8 p 15 refs Transl. into ENGLISH from Mem. Poudres (Paris), v. 41, 1959 p 57–64
(TIL/T.5342)

A simple formula for the reaction of ethylene oxide on water is verified experimentally, and shows that the velocity of reaction is independent of the molecule containing the OH groups. Pure tri-, tetra-, penta-, hexa-, and nepta-ethylene glycols were prepared under optimum conditions. Their principal characteristics and infrared spectra are given. The dinitrates of tetra-, penta-, and hexa-ethylene glycol are described. Author

N63-23498 Du Pont De Nemours (E.I.) and Co., Inc., Wilmington, Del. Experimental Station
POLYMERIZATION OF CONJUGATED TRIENES
Vernon L. Bell [1963] 22 p refs Presented in part at Southeastern Regional Meeting, Am. Chem. Soc., Charlotte, N.C., Nov. 14–16, 1963

The polymerization of 1,3,5-hexatriene, 1,3,5-heptatriene, and 2,4,6-octatriene with a variety of catalysts established the trienes as a distinct class of monomers which lead to unique unsaturated polyolefins. Soluble, high-molecular-weight polymers with predominantly 1,6-enchainment were prepared with a soluble coordination catalyst system; this mode of polymerization resulted in 1,3-dienyl groups in the polymer backbone. A stereospecific poly-1,6-hexatriene, with a novel type of crystallinity based on *trans, trans*-1,3- diene repeat units, was prepared by low-temperature polymerization with a vanadyl trichloride-triisobutyl aluminum catalyst. The preparation of high-molecular-weight polyoctatriene afforded a unique example of homopolymerization of an internal olefin via coordination catalysis. Author

N63-23567 Oak Ridge National Lab., Tenn.
CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JUNE 20, 1963
E. H. Taylor and M. A. Bredig Oct. 25, 1963 154 p refs
(Contract W-7405-eng-26)
(ONRL-3488) OTS: $2.75

Progress is reported in these areas: nuclear chemistry; isolation and chemical properties of synthetic elements; chemical separation of isotopes; radiation chemistry; organic chemistry; chemistry of aqueous systems; electrochemical kinetics and its application to corrosion; nonaqueous systems at high temperature; chemical physics; and water research. C.L.W.

N63-23568 Oak Ridge National Lab., Tenn.
APPARATUS FOR THE GASOMETRIC STUDY OF SOLID-GAS REACTIONS: SODIUM FLUORIDE WITH HYDROGEN FLUORIDE AND URANIUM HEXAFLUORIDE
Sidney Katz Oct. 29, 1963 18 p refs
(Contract W-7405-eng-26)
(ORNL-3497) OTS: $0.50

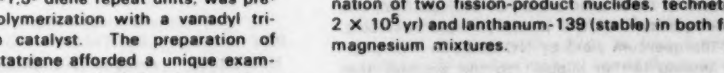
A gasometric apparatus for rapidly characterizing dissociation pressures, sorption equilibrium and kinetics, chemical states and decomposition conditions has been built and tested. The method simply involves the measurement of quantities of gases reacting with or evolving from known quantities of solid. Accuracies of better than ±1% were attained. In testing the capabilities of the new apparatus, the dissociation pressures of hydrogen fluoride and uranium hexafluoride over their respective complexes with sodium fluoride, and the decomposition of the uranium hexafluoride complex to give elemental fluorine were verified. Additionally, a test for sorption of uranium hexafluoride on sodium fluoride was developed, the existence of the compound Na_2UF_8 was demonstrated, a more active form of sodium fluoride was made, the stability of the pentavalent uranium–sodium fluoride complex was studied, data leading to a postulated new compound $(NaF)_2(UF_6)(HF)$ was obtained, and the interaction of hydrogen fluoride and uranium hexafluoride on sodium fluoride was studied. Author

N63-23571 Argonne National Lab., Ill.
CHEMICAL ENGINEERING DIVISION RESEARCH HIGHLIGHTS, MAY 1962-APRIL 1963
Stephen Lawroski, R. C. Vogel, M. Levenson, and V. H. Munnecke [1963] 157 p refs
(Contract W-31-109-eng-38)
(ANL-6766)

Progress reported includes the following areas: (1) the development of pyrometallurgical processes for the recovery of fissionable and fertile materials from short-cooled, high-burnup reactor fuels; (2) fluoride-volatility processes for separating uranium and plutonium in spent nuclear fuel from fission-product elements, and from cladding and alloying materials; (3) fluidized-bed techniques for conducting the direct chemical conversion of fuel materials into gaseous compounds; (4) the determination of heats of formation of zirconium dihydride and zirconium dideuteride by oxygen-bomb calorimetry; (5) reactor safety; (6) the direct conversion of heat from nuclear reactors into electricity; (7) the acquisition of data on fast neutron cross sections for various nuclides; and (8) methods for the determination of two fission-product nuclides, technetium-99 ($t_{1/2}$ = 2×10^5 yr) and lanthanum-139 (stable) in both fission and zinc–magnesium mixtures. I.v.L.

N63-23594 Arizona U., Tucson
SELENIUM DIOXIDE OXIDATION OF OLEFINS Progress Report No. 3
John P. Schaefer and Bert Horvath Oct. 22, 1963 2 p
(Contract DA-ARO(D)-31-124-G257)

The oxidation of $C_6H_5CHDCH{=}CHC_6H_5$ with SeO_2 has been accomplished and the products were degraded according to the following scheme:



On the basis of deuterium analyses of the above six compounds, an isotope effect of 3.9 (k_H/k_D) was calculated at 115° C, indicating that a CH bond is being broken during the rate-determining step of the reduction. Since the saturated ketone contained exactly half of the deuterium which allylic acetate had, a symmetrical intermediate must be formed at some stage of the reaction such that the benzylic carbon atoms become equivalent. That this could not have occurred before oxidation took place has been ruled out by experiments which showed that the starting olefin is stable under the reaction conditions (it does not rearrange). I.v.L.

N63-23613 Bureau of Mines, Albany, Ore. Albany Metallurgy Research Center
FLUORINE ANALYSES: CONTROL METHOD FOR VARIOUS COMPOUNDS
Henry E. Blake, Jr. 1963 34 p 10 refs
(BM-RI-6314)

The difficulty in liberating fluorine from the fluorides of metallic elements such as aluminum, zirconium, and rare earths by steam distillation can be largely overcome if the distillation is made from a sulfuric-phosphoric acid solution of a sodium carbonate fusion of the sample material, and if the distillation temperature is maintained at about 155° C. The data presented in this paper show that liberation of fluorine by this method is more complete and proceeds more rapidly than by usual distillations from perchloric or sulfuric acid alone, or a mixture of phosphoric and perchloric acids. Fluorine in amounts ranging up to about 140 mg can be recovered by collecting only about 300 ml of distillate. Determination of fluoride in the distillate is made by thorium nitrate titration. Author

N63-23619 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
PHOTOLYSIS OF NITROGEN DIOXIDE AT 36600 AND 4047 Å AT 25°C
H. W. Ford and S. Jaffe Repr. from J. of Chem. Phys. v. 38, no. 12, June 15, 1963 p 2935–2942
(NASA Contract NAS7-100)
(NASA CR 52016)

Nitrogen dioxide was irradiated at 3660 and 4047 Å at various pressures of NO_2, with and without CO_2, NO, and N_2 as added gases. The data indicate a primary dissociation at 3660 Å, and shorter wavelengths, corresponding to energies greater than the ON—O bond energy. At 4047 Å, the data are explained by an excited-molecule mechanism. Isotopic oxygen scrambling experiments at 4047 Å indicate the probability of reactions to produce oxygen atoms at that wavelength, but photolysis of NO_2 at trace concentrations and high inert-gas pressures indicates that these atoms are not derived from the unimolecular decomposition of the photoactivated molecule. The inhibition of the quantum yield by NO addition was pressure-dependent, lending further support to the premise that oxygen atoms are important in the mechanism at 4047 Å. It is postulated that the reaction $NO_2^* + NO_2 \rightarrow N_2O_3 + O$ is the source of atomic oxygen. Author

N63-23644 Polytechnic Inst. of Brooklyn, N.Y.
PHOTOCHEMICAL AND SPECTRAL PROPERTIES OF CHLOROPHYLLIN Final Report
Gerald Oster, Judith S. Bellin and Sue B. Broyce May 1963 50 p refs
(Contract AF 19(628)-475)
(AFCRL-63-800)

The infrared and visible absorption spectra and the fluorescence spectra of chlorophyllin *a* were determined, and compared with those of chlorophyll *a*. The infrared spectra showed the absence of a carbonyl group except when chlorophyllin *b* was present as an impurity. This provides the basis of a convenient method of analysis of the chlorophyll *b* content of a given chlorophyll preparation. Since the cyclopentanone ring is absent in chlorophyllin, the observed infrared bands help to clarify those observed in the case of chlorophyll. Author

N63-23670 California U., Berkeley Lawrence Radiation Lab.
CHEMICAL REACTIONS IN CROSSED MOLECULAR BEAMS
James Arnold Norris June 27, 1963 93 p refs
(Contract W-7405-eng-48)
(UCRL-10848)

Crossed molecular beam studies are made of the reactions $K + RI \rightarrow R + KI$, where R is CH_3, C_2H_5, etc. The experimental techniques and theoretical treatment necessary for this study are discussed. From comparisons of the angular distributions of KI observed experimentally with computer-calculated distributions, it has been possible to gain information about the angular distributions of products in the center-of-mass system and about the internal excitation of the products. The results show that 75% to 100% of the energy released in the reaction appears as internal excitation of the products and that the angular distribution is quite anisotropic, with most of the KI recoiling backward (and R forward) with respect to the incoming K beam. This anisotropic distribution indicates that a long-lived reaction complex is not formed, and that any complex that is formed decomposes within a time not much longer than 10^{-12} seconds. Author

N63-23750 Fairfield U. of St. Robert Bellarmine, Inc., Conn.
AN ATTEMPT TO ISOLATE "HOT" RADICAL REACTIONS IN THE PHOTOCHEMICAL DECOMPOSITION OF ACETONE, DIMETHYL MERCURY, n-PROPYL IODIDE AND ISO-PROPYL IODIDE Final Report
Robert E. Varneria Aug. 14, 1963 26 p refs
(Contract AF 19(604)-8806)
(AFCRL-63-849)

Acetone and dimethyl mercury have been decomposed photochemically and thermally alone and in the presence of a nonabsorbing substrate. Due to the complications of side and consecutive reactions and the great difference of temperatures of the two types of reactions, no clear evidence of excess energy was obtained in the radicals produced photochemically. The n-Propyl iodide and iso-propyl iodide have been decomposed photochemically and thermally in the absence of a substrate. Results indicate the possibility that excess energy might be present in the photochemically produced radicals as translational energy primarily. Author

N63-23789 Army Missile Command, Huntsville, Ala.
CHEMISTRY OF CERTAIN INORGANIC FLUORIDES OF NITROGEN
A. V. Pankratov Oct. 8, 1963 Transl. into ENGLISH from Uspek. Khimi., v. 32, no. 3, p 336–353 (1963) refs
(RSIC-77)

A survey is given that is devoted to the chemistry of the enumerated nitrogen fluorides. The survey includes: studies of the structure of the nitrogen trifluoride molecule; physicochemical and chemical properties of tetrafluorohydrazine; studies of difluoramine and chlorodifluoramine; and fluorine azide and isomers of difluorodiazine. C.L.W.

08 COMMUNICATIONS

Includes: communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation.

For tracking stations see: 10 Facilities.

For related information see: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation; and 22 Navigation and Guidance.

N63-23073 Gt. Brit. Ministry of Aviation, Mottingham
MEASUREMENT OF THE DOPPLER FREQUENCY OF A SINGLE RADAR ECHO PULSE. INVESTIGATION OF THE INFLUENCE OF DISTURBANCES ON THE MEASURING ACCURACY [DIE MESSUNG DER DOPPLERFREQUENZ EINES EINZELNEN RADARECHOIMPULSES. UNTERSUCHUNG DES EINFLUSSES VON STOERUNGEN AUF DIE MESSGENAUIGKEIT]
K. Besemer, W. Fogy, and C. Landgraf June 1963 32 p 5 refs
Transl. into ENGLISH of DVL Rept. 149, W. Germany, Feb. 1961 (Previously announced as N62-14277 12-09)
(TIL/T-5376; DVL-149)

The measurement of the Doppler frequency of a single radar-echo pulse in the presence of disturbing interference is investigated by means of a frequency discriminator. The results of the measurements are compared with the theoretical values, giving good agreement, subject to the assumptions. Author

N63-23110 Ohio State U. Research Foundation, Columbus
UTILIZATION OF THE FARADAY EFFECT IN IONOSPHERIC STUDIES Scientific Report No. 19
Byron C. Potts Bedford, Mass., AF Cambridge Res. Labs., Mar. 15, 1963 173 p 59 refs
(Contract AF 19(604)-7270)
(Rept. 1116-28; AFCRL-63-109)

When a linearly polarized antenna is used to receive continuous wave radio transmissions from an artificial earth-satellite, the amplitude of the radio signal exhibits a quasi-periodic fading due to the Faraday polarization rotation of the downcoming wave. This fading may be used to ascertain the electron density as a function of height in the ionosphere by synthesizing the actual conditions that produced the observed rate of fading. Short-term deviations between the calculated values and the experimental values of the rate of Faraday rotation are found to be due to ionospheric irregularities. The application of the Faraday rotation technique to the study of these irregularities is discussed. Author

N63-23121 Technical U., Copenhagen (Denmark)
PARAMETRIC CURVES FOR RADIATION FROM A VERTICAL DIPOLE NEAR A COASTLINE
S. Christiansen and J. Bach Andersen July 1963 22 p 9 refs
(Contract AF 61(052)-503)
(S-74-R-29; AFCRL-63-501)

The vertical radiation pattern from a vertical dipole which is situated on a lossy ground near a perfectly conducting medium is given in a set of parametric curves, which cover all cases of practical interest. The report also contains an approximation of the complex error-function of a complex argument. Author

N63-23131 IIT Research Inst., Chicago, Ill. Technology Center
APPLICATION OF OPERATIONS RESEARCH TO INTERFERENCE, PHASE II Final Report
Bernhard Ebstein and Frederick Bock [1963] 196 p 24 refs
(Contract AF 30(602)-2667)
(IIT-RI-5177-FR; RADC-TDR-63-387)

A number of interference control methods applicable to radar, and various optimization techniques which can be used in conjunction with these control methods are reviewed. Four different optimization algorithms are presented in the form of computer programs written in ALGOL 60. Algorithm 1 finds interference-free frequency assignments, where interference to a receiver from an undesired transmitter has an all-or-none character. Algorithm 2 finds frequency assignments such that interference at any receiver does not exceed a maximum value specified for that receiver, where interference is additive, being measured as the sum per unit time of pulses due to undesired transmitters that exceed the receiver power threshold. Algorithm 3 finds a frequency assignment that minimizes the total interference generated by the set of transmitters (classical assignment problem of operations research). Algorithm 4 finds a frequency assignment that minimizes the maximum interference generated by any one of the transmitters (bottleneck assignment problem). Examples are presented illustrating the application of these techniques. Author

N63-23137 Bendix Corp., Baltimore, Md. Bendix Radio Div.
SOLID STATE AMPLIFIER TECHNIQUES [Final Report, June 15, 1962-June 14, 1963]
Donald Mac Glashan Wright-Patterson AFB, Ohio, AF Avionics Lab., Sept. 30, 1963 187 p 17 refs
(Contract AF 33(657)-9191)
(ASD-TDR-63-845)

The final receiver, which contained two cascaded tunnel diode amplifiers integrally mounted in a five port circulator, a crystal mixer, a tunnel diode local oscillator, a dual conversion IF amplifier, and regulated power supplies, measured 6 by 6 by 2 inches and weighed 5.5 pounds. The pertinent characteristics for this receiver were 3.2 db system noise figure, 40 db gain, and 20 percent RF bandwidth. Author

N63-23146 Federal Aviation Agency, Washington, D.C.
RADAR QUALITY CONTROL FEASIBILITY EXPERIMENT Final Report
Jan. 1963 138 p

The data collection portion of the experiment was performed on the modified ASR-2 and the FPS-8 radar systems for a period of 30 days. An analysis of the data collected indicated that it is both technically and economically feasible to perform radar flight inspection by utilizing user aircraft. It is estimated that approximately the same information presently being collected by periodic flight inspection could be collected with user aircraft for approximately one-fourth to one-third of the cost. Conversely, for the same cost as the present periodic flight inspection, approximately three to four times the information could be obtained by making use of the user aircraft technique. In addition, since the user data would be collected on a daily basis, degraded performance would be recognized earlier. Author

N63-23154 Naval Research Lab., Washington, D.C.
FERRITE-LOADED OPEN TRANSMISSION LINE [Interim Report]
M. L. Reuss, Jr., and W. H. Mendenhall, Jr. Feb. 20, 1963 10 p
(NRL-5867)

The propagation characteristics of an open ferrite-loaded waveguide have been studied at both X- and S- bands. Relative phase shift and insertion loss were measured at low power levels, while insertion loss alone was measured at high-peak power levels. This open-transmission-line geometry is suitable for use when a small switching time is required, since the "shorted-turns" effect is reduced to a minimum. In general, there appears to be no major difference between the propagation characteristics of the open ferrite-loaded transmission line and the characteristics of a standard waveguide having the same ferrite configuration. Author

N63-23158 Lockheed Electronics Co., Plainfield, N.J.
THE CHECKOUT AND MAINTENANCE (CAM) TRAINER. I: INSTRUCTIONS AND PROGRAMS FOR USE

Eugene R. Hall, John A. Modrick, and Paul R. Richard Wright-Patterson AFB, Ohio, Tech. Training Branch, June 1963 46 p (Contract AF 33(616)-7584)
(AMRL Memo. P-39)

The report provides a brief description of the CAM trainer, detailed instructions for its operation, and the instructional programs prepared for use with the trainer. These programs teach checkout procedures, and other information relevant to the operation of the radar system used with the trainer. The CAM trainer was developed for use in research to improve electronic maintenance. It includes an AN/ASB-4 radar bombing navigational system, special electronic equipment to make the system function on the ground, a specially constructed device for presenting instructions to a student, and equipment to measure the student's performance. Author

N63-23159 Aerospace Medical Div., Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio
THE CHECKOUT AND MAINTENANCE (CAM) TRAINER
Eugene R. Hall May 1963 15 p
(AMRL-MEMO-P-35)

The Checkout and Maintenance (CAM) Trainer is a major device that has been specially constructed for research on electronic maintenance. The device has been designed to support research on problems such as the following: determining the major sources of difficulty in electronic maintenance; specifying the most efficient techniques and devices for training and aiding electronic-maintenance personnel; and developing effective techniques for evaluating the proficiency of personnel performing electronic maintenance. Author

N63-23169 Weapons Research Establishment (Australia)
CARTESIAN VELOCITY ERRORS ASSOCIATED WITH THE FPS16 RADARS AT WOOMERA
R. H. Evans Aug. 1963 36 p 7 refs
(ADS-128)

Formulae are derived for the estimation of random errors in Cartesian velocity components as computed from the FPS 16 radar output. The formulae are used to produce error contours in the plane x = 0 at Range E, Woomera, for various smoothing parameters. Author

N63-23197 Comitato Nazionale per l'Energia Nucleare, Frascati (Italy) Lab. Nazionali
RADIOFREQUENCY SYSTEM FOR THE PROJECT ADONIS 1500 MeV [IMPIANTO A RADIOFREQUENZA PER IL PROGETTO ADONE 150 MeV]
D. Fabiani, A. Massarotti, M. Puglisi and F. Tazzioli July 31, 1963 44 p 5 refs In ITALIAN
(LNF-63/53; *Its* Nota Interna 209)

The parameters and characteristics for a radiofrequency system for use in high-energy particle accelerators are given. The system has been designed to furnish high voltages for periods up to 50 hours. Trans. by P.F.E.

N63-23305 Air Force Cambridge Research Labs., Bedford, Mass.
OPERATIONAL CONCEPTS OF PHOTOGRAMMETRIC DETERMINATION OF AZIMUTHS OVER INTERMEDIATE DISTANCES
Michael S. Tavenner and Paul B. Swenson *In its* Compendium of Papers in the Fields of Geodesy and Planetary Geometry Aug. 1963 14 p refs Presented at the 43rd Ann. Meeting, Amer. Geophys. Union, Washington, Apr. 1962 (See N63-23301 24-01)

A technique has been developed for determining azimuths over intermediate distances to an accuracy of ±1.0 second of arc. Utilizing geodetic stellar camera systems, an airborne 2000 watt-second flashing light source, and effective communications and navigation techniques, photographs of the light are made simultaneously from both ends of the line as the aircraft crosses the midpoint of the line. The resultant plates, containing the flash images and the calibrated stellar background, can be reduced to the required accuracy. Author

N63-23350 Lincoln Lab., Mass. Inst. of Tech., Lexington
OPTIMUM POWER DIVISION IN COHERENT COMMUNICATION SYSTEMS
H. L. Van Trees Feb. 19, 1963 51 p 9 refs

This report considers the optimum way to divide the available energy between the channel measurement and information transfer functions. Specifically considered is a binary, symmetric, phase-modulation system operating over a channel which imparts a random phase modulation to the signal and adds Gaussian noise. For the range of signal and channel parameters considered, the probability of error is minimized by devoting all available energy to transmitting information, and to operating on the information sequence to measure the channel. The exact quantitative results depend on the statistics of the channel variations. It is concluded that from the theoretical standpoint, the modulation waveform should always be used as part of the synchronization system. Under a wide variety of conditions, the best strategy is to devote all the available power to modulation, and to obtain the synchronizing information by performing some operation on the incoming signal which removes its dependence on the data. Author

N63-23377 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INSTANTANEOUS VALUE COMPANDING IN PULSE MODULATED COMMUNICATION SYSTEMS
W. Glaser Sept. 19, 1963 39 p 2 refs Transl. into ENGLISH from Nachrichtentechnik (E. Berlin), no. 3, 1961 p 106–114
(FTD-TT-62-32/1+2)

A method is described for instantly companding the values of a time-modulated signal. This method can be applied to pulse-modulated systems. Improvement of various communication system parameters are obtained by pre-emphasis on the transmitter side and an adequate distortion-correction on the receiver side of the information to be transmitted. The values of signal-to-noise ratio improvement, made available by the method described, are derived. Essential information is given on tolerance determination of certain equipment parameters. I.v.L.

N63-23431 National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
LUNAR OCCULTATIONS OF TWO DISCRETE RADIO SOURCES IN 1963–1964
John A. Eddy Oct. 11, 1963 23 p refs
(NBS-TN-184) GPO: $0.20

The bright, extended radio sources Taurus A and IC443 lie close to the ecliptic and are occulted by the moon about every 8 1/2 years, providing rare opportunities to study their angular brightness distribution with very high resolution. The nature of the next series of occultations of these sources, which will occur during the period from November 1963 through August 1964, is discussed. Author

N63-23439 Bell Telephone Labs., Inc., Murray Hill, N.J.
INTERNATIONAL COMMUNICATION AND SPACE
John R. Pierce *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 35–49 (See N63-23436 24-01) (Lecture 3)

Plans for international communication using satellites are discussed. The advantages and disadvantages of reflecting spheres, active transmitters, belts composed of multitudes of fine wires, networks of low-altitude satellites, and 24-hour stationary satellites for global communications are examined. The technical and budgetary problems associated with satellite communication require the type of international cooperation pioneered by the International Communications Union under the auspices of the United Nations for the worldwide telephone cable network. M.P.G.

N63-23576 Aerospace Corp., El Segundo, Calif.
COMMUNICATION LINK PERFORMANCE
F. F. Yates Aug. 1963 37 p 14 refs
(Contract AF 04(695)-269)
(TDR-269(4111)-1; SSD-TDR-63-197)

The topics discussed are: (1) output S/N of FM analog demodulators; (2) data rate capability for digital signals; (3) frequency tracking and acquisition capability of a phase-lock loop; (4) required one-second Oscillator stability for tracking by phase-lock loop; (5) P_s/n of transmission links (performance); (6) space loss; and (7) slant range. Author

N63-23581 Innsbruck U. (Austria)
PROPAGATION OF VLF WAVES IN LIQUID AND SOLID MEDIA Technical Note No. 3
Wolfram Bitterlich July 15, 1963 6 p 1 ref
(Contract AF 61(052)-490)
(AFCRL-63-383)

The conductivity σ of a homogeneous dissipative medium can be determined from measurements of the field strength of a magnetic dipole operated in this medium at a very low frequency. As is shown by calculations, the limited measurement accuracy of experimental equipment requires minimum measurement distances r_{min} to get reasonable results. The r_{min} is calculated as a function of frequency and conductivity and compared with experimental data. Author

N63-23601 RAND Corp., Santa Monica, Calif.
DESIGN AND USE OF AN EARLY COMMUNICATION SATELLITE SYSTEM
L. D. Attaway, L. B. Early, N. E. Feldman and E. E. Reinhart July 1963 118 p refs
(NASA Contract NASr-21(02))
(NASA CR-52150; RM-3514-NASA) OTS: $9.60 ph, $3.74 mf

A study is presented of the feasibility of applying current satellite techniques to provide, without extensive research and development programs, two types of communication services: (1) low-capacity communications between the United States (primarily for the U.S. Government) and all areas of the world in which U.S. governmental interests exist; and (2) medium-capacity service between, and to the rest of the world from, the underdeveloped nations. Only simple satellites of the general type of Telstar and Relay were considered "available," and the choice of launch vehicles was limited to Thor-Delta and Atlas-Agena. For governmental service where visibility to all points is desirable, relatively high satellite orbits, in near polar inclinations, are best. A satellite system to provide service between and from underdeveloped nations would best use satellites at medium altitudes and 30° inclination, because of the geographical locations of these countries. P.V.E.

N63-23647 Electronic Communications Inc., Timonium, Md. Research Div.
PSEUDO RANDOM ARRAY INVESTIGATION
J. W. Sherman, M. E. Thomas, and M. I. Skolnik Griffiss AFB, N.Y., Techniques Lab. Sept. 1963 59 p 5 refs
(Contract AF 30(602)-3057)
(RADC-TDR-63-380)

This report describes the technique of dynamic programing and its application to antenna array theory. The changes required in the program for linear arrays are discussed in detail, and the proposed methods of application of dynamic programing to planar arrays are presented. Author

N63-23651 Hughes Research Labs., Malibu, Calif.
AN INTRODUCTION TO MULTIPLE ACCESS SATELLITE COMMUNICATION Report No. 5
S. G. Lutz Feb. 1963 56 p 10 refs
(NASA Contract NASw-495)
(NASA CR-52200) OTS: $5.60 ph, $1.88 mf

The aspects treated include adaptability of multiple-access systems, orbital constraints with regard to communication coverage and economics, modulation and multiplexing requirements, and possible calling techniques with associated problems. Author

N63-23701 Electronic Communications, Inc., Timonium, Md. Research Div.
WIDE BAND LUNAR RELAY COMMUNICATIONS Final Report
W. M. Waters, J. O. Wedel, and J. W. Sherman May 16, 1963 44 p 23 refs
(Contract AF 19(628)-398)
(AFCRL-63-332)

This study describes and analyzes an approach to the problem of increasing lunar relay bandwidth. An adaptive receiving array is described which makes possible the use of exceptionally large apertures capable of being focused on a small spot on the lunar surface. However, an analysis shows that sidelobe effects considerably reduce expected bandwidth gains. A bandwidth of 25 kc is calculated for a 1000 ft^2 X-band array which employs a "maximum energy" taper. Between 256 and 1024 array elements are required. Author

N63-23705 Weapons Research Establishment (Australia)
SIMULATION FACILITIES AND SYSTEM TESTS FOR THE DIGITAL IMPACT PREDICTOR
K. W. J. Todd Aug. 1963 18 p refs
(PAD-72)

A comprehensive tracking and computation system will be used at the Woomera Range to satisfy requirements for ballistic rocket firings. Part of this system is a Digital Impact Predictor which is fed with tracking data from AN/FPS16 radars. This paper describes the tests and simulation facilities which have been designed to aid in achieving satisfactory performance with the Digital Impact Predictor, to integrate it into its Range environment, and to provide a means of testing the system as a whole. Author

N63-23804 Geoscience Inc., Cambridge, Mass.
RESISTIVITY INVESTIGATION ON CAPE COD
T. Cantwell and P. Nelson Sept. 1963 16 p
(Contract AF 19(628)-2351)
(Scientific Rept. 3-2351; AFCRL-63-370)

A resistivity survey was carried out to investigate the site of a deep strata communication experiment. The purpose of the resistivity measurements was threefold: (1) to determine if measurements of resistivity by novel techniques from the surface could be used to investigate the properties of deep strata propagation paths; (2) to determine whether the resistivity

measurements made on the core from the Tubman Hole are representative of all the granite at depth; (3) to investigate whether such properties of deep strata propagation as can be determined by resistivity methods are representative of those found in attempting to propagate radiofrequency electromagnetic energy. As a result of the measurements and subsequent interpretation, it is concluded that resistivity methods can be used to determine the properties of buried layers.
Author

N63-23817 Hughes Research Labs., Malibu, Calif.
PRELIMINARY STUDY OF MODULATION SYSTEMS FOR SATELLITE COMMUNICATION
S. Plotkin June 1963 69 22 refs
(NASA Contract NASw-495)
(NASA CR-51993; Rept. 6R) OTS: $6.60 ph, $2.27 mf

A comparative study of power and bandwidth requirements for SSB, FM, and PCM modulation systems is given, as related to multiple-access satellite communications. Composite power-loading factors for multichannel speech are treated as a function of the number of channels. Actual system requirements for each of the three systems are then given with respect to an assumed reference application. Multiple-access considerations show that serious difficulties arise in both all-FM and all-PCM systems. Thus, the concluding modulation system choice is SSB for the up link, and wideband FM for the down link. It was further concluded that frequency division multiplex is preferable to time division multiplex. Author

09 ELECTRONICS

Includes: circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory.

For related information see: **06 Auxiliary Systems; 08 Communications; 15 Instrumentation; 22 Navigation and Guidance; and 25 Physics, Solid-State.**

N63-23030 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CLOSED FORM SOLUTION TO CONTROL EQUATIONS
J. F. Andrus July 30, 1963 22 p 2 refs
(NASA TM X-50813; MTP-COMP-63-2) OTS: $2.60 ph, $0.86 mf

The paper shows how one may avoid the unreasonably small step size required for the numerical integration of some systems of linear, ordinary, differential equations with nearly constant coefficients. The nonhomogeneous parts of the equations are represented by polynomials over short time intervals, and closed-form expressions for the integrals on these time intervals are obtained in terms of the polynomial coefficients. The paper is particularly concerned with equations representing electrical networks utilized in missile control systems. Author

N63-23042 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EVALUATION OF CRITICAL PROPERTIES OF SELECTED MATERIALS FOR ELECTRONIC PACKAGING PURPOSES [Monthly] Summary Report [No. 3] May 1-30, 1962
Jay W. De Dapper (Redel, Inc.) June 1, 1962 14 p
(JPL-Purchase Order F2-177911)
(NASA CR-51587; RML-3) OTS: $1.60 ph, $0.80 mf

Evaluations were made of the critical properties of selected materials for electronic packaging purposes. Included were mechanical, electrical, and physical tests of adhesives, conformal coatings, potting compounds, and foams. C.L.W.

N63-23058 Arizona U., Phoenix
A NONSATURATING TRANSISTOR SWITCH FOR ANALOG/HYBRID INSTRUMENTATION AND COMPUTERS
Thomas A. Brubaker May 1963 22 p 4 refs
(ACL Memo. 78)

.Two nonsaturating switching elements, a two-transistor nonsaturating switch, and a four-transistor nonsaturating switch, which act as both current amplifiers and as switches, are described. The switches have low leakage, fast recovery, and when combined with fast, transistorized operational amplifiers, such precision analog–hybrid circuits as analog memory elements and switched inverting amplifiers can be made to operate at frequencies up to 100 kc, with switching rates to 50 kc. I.v.L

N63-23072 New Electronics Lab., San Diego, Calif.
AUDIO FREQUENCY GENERATORS USING SILICON CONTROLLED RECTIFIERS. POWER INVERTERS THAT DELIVER 0.5-MEGAWATT PULSES, AT 10 TO 700 C/S, FROM DC OR THREE-PHASE AC SOURCES
J. T. Redfern July 17, 1963 22 p
(NEL-1175)

Two experimental silicon-controlled rectifier (SCR) inverters able to deliver 0.5-mw pulses in the frequency range from 10 to 700 cps were built and tested. One operates from a dc source and the other, containing its own rectifier, operates from a three-phase ac source. The former has been successfully used at sea. These SCR inverters offer considerable weight and size advantages over conventional audiofrequency generators. Author

N63-23100 University of Southern Calif. Engineering Center, Los Angeles
DESCRIPTION OF A RADIO-FREQUENCY ENERGY SOURCE
Eugene F. Lovejoy Mar. 29, 1963 16 p
(USCEC 65-54)

An RF power generator designed to provide radiofrequency energy for the experimental heating of supersonic gas flows is described. It has the following specifications: (1) power output—continuously variable with a two-kilowatt maximum; (2) frequency—nominally 13 megacycles, but can be modified to operate from 6 to 30 megacycles; (3) output impedance—any resistive load impedance from 50 to 300 ohms; and (4) main power supply—208 to 220 volts, ac single phase. Frequency stability is more than adequate since the exciter is crystal controlled. Spurious oscillation of the final amplifier did not occur at any power level after the amplifier was neutralized. P.V.E

N63-23106 Massachusetts Inst. of Tech., Cambridge Instrumentation Lab.
USE OF MODEL-REFERENCE ADAPTIVE CONTROL TO ACHIEVE A SPECIFIED PERFORMANCE
H. Philip Whitaker Apr. 1963 20 p 11 refs
(Contract AF 04(694)-305)
(R-407)

The characteristics of model-reference adaptive control systems are reviewed, and the application of such systems to the control of nonlinear systems and, inversely, to the problem of measuring system characteristics is discussed. The model-reference concept enables a system to change its compensation parameters in a closed-loop manner so as to achieve a

specified performance. Fundamentally, the model is the specification of the desired response of the system, based on engineering judgment identifying what constitutes acceptable performance. Rather than identifying actual system performance, the model provides a signal representation of the error between the actual and the desired performance at all times. As an example of the control of a nonlinear system, the application of the model-reference system to the attitude control of a satellite with a saturating moment-producing device is discussed. The possibilities of using the model-reference concept (1) in a learning adaptive system, (2) for response limitation, and (3) to identify vehicle characteristics are examined. M.P.G.

N63-23109 Ohio State U. Research Foundation, Columbus Antenna Lab.
A TRANSISTOR PHASE SHIFTER AND CHOPPER DRIVE AMPLIFIER
John Robert Baechle Mar. 23, 1962 16 p 4 refs
(Contract AF 30(602)-2214)
(Rept. 1075-13; RADC-TDR-63-16)

A transistorized power amplifier and phase shifter with the phase continuously variable from 0° to 360° is described. The circuit is essentially broadband with the exception of the phase shifter which was designed to operate at 1 kc but which can easily be modified to operate at other frequencies. If a broadband amplifier is desired, the phase shifter can be deleted from the circuit. At the design frequency, the circuit performs equally well when connected to either a 15 or 25 v, 100 ma power supply. Author

N63-23116 Texas Instruments Inc., Dallas
TECHNIQUES FOR EXPERIMENTAL FABRICATION OF A 1-WATT, 1-GC GALLIUM ARSENIDE TRANSISTOR Second Quarterly Progress Report, 1 Nov. 1962-31 Jan. 1963
H. L. Henneke [1963] 32 p 1 ref
(Contract AF 33(657)-8757)
(TI-08-63-20)

Data on zinc diffusion through a SiO_2 film covering the gallium arsenide show that the surface concentration may be significantly reduced by this means and that near complementary error function distributions of the zinc may be obtained. Adding elemental arsenic to the diffusion ampoule had no effect on the impurity distribution, but markedly reduced the loss of arsenic from the unprotected side of the wafers. A new method of diffusing impurities in gallium arsenide is described. The impurity is incorporated into a sputtered SiO_2 film on the gallium arsenide wafers. Planar diodes have been constructed utilizing this process, and the preliminary results indicate extremely uniform and reproducible diffusions of zinc. The presence of copper as a contaminant has been shown to affect the diffusion profile of manganese. Radiotracer studies of manganese also indicate an anomalous behavior. Author

N63-23118 General Telephone and Electronics Labs., Inc., Bayside, N.Y.
STUDY OF FAILURE MECHANISMS IN HIGH POWER RADIO FREQUENCY GENERATING DEVICES Third Quarterly Report
M. Friedman Axler, R. A. Hein, and T. G. Polanyi Sept. 30, 1962 42 p refs
(Contract AF 30(602)-2595)
(TR62-254.3; RADC-TDR-62-615)

The causes of failures in gridded high-power traveling-wave tubes are being studied through an examination of the gas ambient of operating tubes and of the individual tube components. Omegatron mass spectrometers permanently attached to the unit under test are used for measuring the gas ambient. Data on the total gas content of tube materials which can be released upon heating have been determined by a hot-extraction method used in conjunction with a conventional analytical mass spectrometer; such data are reported for stainless-steel and nicoseal tube components. Emission spectrographic analyses for impurities in alundum-coated heater coils are reported. Author

N63-23144 Rand Corp., Santa Monica, Calif.
A GENERAL VIEWPOINT ON SHIFT-REGISTER SEQUENCES
I. S. Reed Oct. 1963 26 p 6 refs
(Contract AF 49(638)-700; Project RAND)
(RM-3874-PR)

The design theory of shift-register counters is examined with emphasis on the synthesis of counters able to create extremely long sequences by sequentially modifying the effective connections or "operators" in the feedback loop. Nonlinear shift-registers are examined in order to find the possible directions which might yield maximal length sequences with a minimum of equipment. This approach has led to the creation of nonrepeating sequences longer than the limit formerly thought to exist, which was 2^k-1, where k is the number of stages of the register. This approach is particularly adapted to forming registers out of passive memory elements, such as acoustical wire delay lines or magnetic drums. Such elements would have very few "taps" or read/write heads, and would need little logic to perform the required transformations. I.v.L.

N63-23174 Applied Physics Lab., Silver Spring, Md.
AN ANALOG TRIODE-DIODE FUNCTION GENERATOR
Calvin J. Nisson May 1963 95 p 13 refs Based on M.S. Thesis
(Contract NOw-62-0604-c)
(Bumblebee Rept. 318)

The detailed design of a practical triode-diode function generator is carried out stage by stage, and the transfer function for each stage is obtained. Stability of the function generator is studied both in terms of it being a linear system and a simple nonlinear system. The triode-diode function generator is evaluated analytically and by testing a prototype. Test procedures are described and evaluated. A quantitative comparison of errors due to drift, noise, and bandwidth, is made between diode function generator and the triode-diode function generator for a particular case. Author

N63-23184 Raytheon Co., Waltham, Mass.
BEHAVIORAL PLANNING NETWORKS
Gustave J. Rath Bedford, Mass., AFSC Decision Sci. Lab., Aug. 1963 13 p Presented at the Ann. Meeting of the Natl. Soc. for Programed Instruction, San Antonio, Mar. 29, 1963
(Contract AF 19(628)365)
(ESD-TDR-63-607)

The behavioral planning network is the technique and method describing the organization of the operational specifications of performance which precede the programing activity. Author

N63-23286 McGill U., Montreal (Canada) Eaton Electronics Research Lab.
ANNUAL REPORT TO THE OFFICE OF NAVAL RESEARCH [RESEARCH IN THE AREA OF HIGH FIELD MAGNET SYSTEM]
R. Stevenson Aug. 1963 64 p refs
(Contract Nonr-3013(00))

CONTENTS:

1. INTRODUCTION R. Stevenson p 1–2
2. DESIGN OF TWO REGION SOLENOIDS R. Stevenson p 3–9 refs (See N63-23287 24-09)
3. DESIGN OF A 300,000 OER. TWO REGION SOLENOID FOR INTERMITTENT OPERATION R. Stevenson p 10–37 refs (See N63-23288 24-09)
4. TRANSVERSE MAGNETORESISTANCE OF HIGH-STRENGTH COPPER ALLOYS R. Stevenson and R. Bolton 5 p (See N63-23289 24-18)
5. SUSCEPTIBILITY OF IRON GROUP COMPOUNDS IN HIGH MAGNETIC FIELDS R. Stevenson 9 p (See N63-23290 24-09)
6. THE APPROACH TO PARAMAGNETIC SATURATION R. Stevenson 10 p refs (See N62-17856 19-21)

N63-23287 Mc Gill U., Montreal (Canada) Eaton Electronics Research Lab.

DESIGN OF TWO REGION SOLENOIDS

Richard Stevenson *In its* Annual Rept. to ONR [Res. in the Area of High Field Magnet System] Aug. 1963 p 3–9 refs (See N63-23286 24-09)

(Sponsored by ONR and DRB)

A two-region solenoid consists of an inner solenoid placed within the bore of a large outer solenoid. It is shown that a two-region solenoid can always be built which has a higher magnetic efficiency (lower power consumption) than a single solenoid producing the same field over the same volume. The two-region solenoid also gives an important reduction in the stress level. Author

N63-23288 Mc Gill U., Montreal (Canada) Eaton Electronics Research Lab.

DESIGN OF A 300,000 OER. TWO REGION SOLENOID FOR INTERMITTENT OPERATION

Richard Stevenson *In its* Annual Rept. to ONR [Res. in the Area of High Field Magnet System] Aug. 1963 p 10–37 refs (See N63-23286 24-09)

(Supported by ONR and DRB)

This paper contains a design of an aluminum solenoid magnet capable of producing a field of 300,000 G over a bore of 5.8 cm. The magnetic field is produced by a two-region solenoid operated at 15° K and cooled by compressed helium gas. Details of the structure are described, and calculations are given for all important parts of the cooling system. The magnet is designed for a minimum total operating time at maximum power of about 40 minutes in a week. The low capital expense of the system makes it suitable for installation in small laboratories. Author

N63-23290 Mc Gill U., Montreal (Canada) Eaton Electronics Research Lab.

SUSCEPTIBILITY OF IRON GROUP COMPOUNDS IN HIGH MAGNETIC FIELDS

Richard Stevenson *In its* Annual Rept. to ONR [Res. in the Area of High Field Magnet System] Aug. 1963 9 p refs Repr. from Can. J. Phys., v. 40, 1962 p 1385–1393 (See N63-23286 24-09)

(Supported by ONR and DRB)

Experimental studies of the magnetic susceptibility of $NiCl_2$, $CrCl_3$, $CoCl_2$, $FeSO_4$, $CoSO_4$, $CoSO_4 \cdot 7H_2O$, Cr_2O_3, $MnBr_2$, $MnCO_3$, $MnSO_4$, $MnSO_4 \cdot H_2O$, and MnO_2 measured with fields up to 500,000 oersteds are presented. The first eight substances show constant susceptibilities in the experimental region, whereas the last four show increases of varying size. The increases can be correlated to a certain extent with low field properties, and the hypothesis is put forward that they are due to a change in stability of the paramagnetic substances involving an alteration of the exchange coupling. Author

N63-23347 Hyletronics Corp., Burlington, Mass.

MICROWAVE STUDIES OF SEMICONDUCTING DIAMONDS Final Report

M. H. Sirvetz June 15, 1963 44 p refs

(Contract AF 19(628)-454)

(AFCRL-63-378)

Microwave techniques have been applied to an investigation of the electrical conduction properties of semiconducting diamonds. Techniques of dealing with specimens as small as 1 mg in size have been emphasized. Measurements of microwave loss have been made as a function of temperature in the range −50° C to +50° C and analyzed by means of cavity perturbation theory. The activation energies and resistivities deduced from these data have been in agreement with the results of dc measurements where the comparison could be made. Author

N63-23375 Sylvania Electronic Systems, Waltham, Mass. Applied Research Lab.

RESEARCH PROGRAM TO EXTEND THE THEORY OF WEIGHT DISTRIBUTION AND RELATED PROBLEMS FOR CYCLIC ERROR-CORRECTING CODES Summary Scientific Report

H. Frazyer Mattson, Jr. July 1963 31 p 7 refs

(Contract AF 19(604)-8516)

(S-1015-2; AFCRL-TDR-63-321; AD-449-000)

Methods of induced representation are applied to questions of weight distribution in certain quadratic residue codes. If the prime p denotes the block length of this cyclic $(p,(p+1)/2)$ code (over GF(q) for certain q), the coordinate indices are identified with the finite points on the projective line over GF(p). A new coordinate is then introduced for the infinite point, so that the code is replaced by a $(p+1, (p+1)/2)$ code. The main result is that this new code is invariant under the permutation of coordinates (with sign changes, in general) induced by the projective unimodular group acting on the coordinate indices. In addition, a class of cyclic codes over GF(2) of block length 3p, where p is prime and 2 has even multiplicative order h modulo p, are defined. These codes have the property that all odd weights in them are at least p. When p has the form $2^m + 1$, the minimum weight in this $(3p, 2m+1)$ code is $p+2$; this result and its proof are analogous to those for maximal-length-sequence, or Singer codes, in which $p = 2^m - 1$. The (3p,h) code is related to a (p,h/2) cyclic code over GF(4). Specifically, the codes correspond naturally and in such a way that each vector in the long code has twice the weight of the corresponding vector in the short code. Author

N63-23405 Innsbruck U. (Austria)

ATTENUATION IN SUBSURFACE SIGNAL TRANSMISSION Technical Note No. 2

H. Scotti and I. Steinacker July 15, 1963 10 p

(Contract AF 61(052)-490)

(AFCRL-63-382)

The attenuation factor and the relative field strength were calculated for both sky and surface waves, for a wide range of variables, in order to get a clear picture as to whether and how the sky waves and the surface waves differ from each other when they penetrate into the conducting ground. I.v.L.

N63-23419 Burroughs Corp., Paoli, Pa. Burroughs Labs.
COMBINED ENVIRONMENTAL TESTING OF SEMICONDUCTOR DEVICES Final Report No. 4, 15 June 1962-15 June 1963
Alton L. Long [1963] 172 p
(Contract DA-36-039-sc-90766)

Preliminary experiments were conducted to select cable type, configuration, and instrumentation techniques for the primary experiment. The primary experiment yielded over 500 transient response measurements of leakage current, voltage saturation, and current gain, on 2N559, 2N599, 2N708, and 2N914 devices. Collector-base leakage for each of the four devices increased during the radiation pulse and afterward returned to essentially its initial value. When the leakage pulse was considered as added base drive, equivalent device gain was reduced during the pulse. The germanium units showed little permanent damage while the silicon units suffered a 15 to 25 percent permanent gain reduction at the highest flux level. The saturation voltage of the germanium units decreased during the pulse as a result of the drive provided by the leakage current. The silicon transistors exhibited a small increase which followed the integrated dose. Author

N63-23433 Avco-Everett Research Lab., Everett, Mass.
A HALL GENERATOR WITH WIRE ELECTRODES
A. W. Carlson Sept. 1963 20 p 3 refs
(Contract AF 04(694)-33)
(Avco-Everett Res. Rept.-165; BSD-TDR-63-196)

In an MHD generator of small size, it is desirable to have the electrodes in contact with the hot gas in the free stream. This can be most surely accomplished for a Hall generator by employing wire electrodes which extend entirely across the interior of the channel. The wire electrodes lie in one or more planes perpendicular to the magnetic field, each wire being perpendicular to the direction of the gas flow. The electrical performance of a Hall generator with this geometry is calculated and found to depend on the Hall parameter, $\omega\tau$, and on the height-to-width ratio of the channel cross section.

Author

N63-23455 Massachusetts Inst. of Tech., Cambridge School of Engineering
RESEARCH ON MATERIALS, PROCESSES, AND DEVICES RELATED TO ENERGY CONVERSION Final Technical Summary Report, Scientific Report No. 8
May 31, 1963 135 p refs
(Contract Nonr-1841(78), Amend. 2; ARPA Order 214-62)

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2. SUPERCONDUCTIVITY IN MULTIPHASE MATERIALS
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4. FLOW ELECTRODES WITH MIXED FUEL AND OXIDANT
5. CELL THERMODYNAMICS

APPENDIX II-A: PREDICTED PERFORMANCE OF AIR ELECTRODES H. P. Meissner and A. R. Reti 21p refs (See N63-23457 24-09)

APPENDIX II-B: FUEL CELLS USING FLOODED FLOW ELECTRODES H. P. Meissner and A. R. Reti 14 p refs (See N63-23458 24-09)

III. HIGH TEMPERATURE METALLURGY RESEARCH ON THERMOELECTRIC AND THERMIONIC MATERIALS N. J. Grant et al 14 p refs

1. PHASE DIAGRAM INVESTIGATIONS
2. DEFORMATION AND FRACTURE OF THERMOELECTRIC MATERIALS
3. PREPARATION AND EVALUATION OF Mo-ThO_2 THERMIONIC EMITTER MATERIALS

IV. SOLID STATE ENERGY CONVERTERS D. C. White et al 3 p refs

1. GRADED ENERGY GAP SEMICONDUCTOR DEVICE
2. RADIATION DAMAGE OF SEMICONDUCTORS AND SEMICONDUCTOR DEVICES
3. TRANSPORT PROPERTIES OF ZINC-ANTIMONIDE
4. THE THERMO-PHOTO-VOLTAIC EFFECT AND ITS UTILIZATION IN ENERGY CONVERSION

V. DEVELOPMENT OF THERMIONIC EMITTER MATERIALS E. N. Carabateas, A. Shavit, R. Vanderweil, Jr., J. R. Bledsoe, P. Klimowski et al p 35-60 refs (See N63-23459 24-09)

1. INTRODUCTION
2. THE DESIGN AND CONSTRUCTION OF A CESIUM THERMIONIC CONVERTER WITH MONOCRYSTAL MOLYBDENUM EMITTER
3. BINARY MIXTURE EMITTERS
4. ANALYTICAL STUDIES OF SURFACE FILMS

N63-23456 Massachusetts Inst. of Tech., Cambridge School of Engineering
JOINING CURRENT CONTACTS TO SUPERCONDUCTING WIRE
K. M. Ralls, A. L. Donlevy, R. M. Rose, and J. Wulff *In its* Res. on Mater., Processes, and Devices Related to Energy Conversion May 31, 1963 35 p refs (See N63-23455 24-09)

The joining of current contacts to superconducting wires was investigated. Results indicate that: (1) the superconducting critical current level of niobium-zirconium alloy wire can be markedly influenced by the nature of the current contact to normal materials; when contact resistance is much above 10 microhms, the shape and magnitude of the critical current-critical field curve change; (2) the physical nature of the current contact interface is best described by the Holm model; rough calculations based on the Holm model yield reasonable results and predict a large change in behavior between 10 and 100 microhms; and (3) the two best techniques for making current contacts to niobium-zirconium alloy wire are based on spot welding to platinum foil and ultrasonic soldering with indium.

I.v.L.

N63-23457 Massachusetts Inst. of Tech., Cambridge School of Engineering
PREDICTED PERFORMANCE OF AIR ELECTRODES

H. P. Meissner and A. R. Reti *In its* Res. on Mater., Processes, and Devices Related to Energy Conversion May 31, 1963 21 p refs (See N63-23455 24-09)
(Contracts AF 33(616)-7642 and Nonr-1841(78), Amend. 2; ARPA Order 214-62, Amend. 2)

Screens of smooth platinum wire were studied as electrodes. The electrolyte, namely, aqueous KOH solution containing dissolved oxygen, was caused to flow through the electrode screens, and the effect of oxygen concentration and flow velocity on the voltage-current density curves explored. The results are used to calculate performance of porous gas-diffusion-type electrodes containing several different idealized pore systems. These calculations indicate that only the pore wall area lying near the electrolyte-gas meniscus is electrochemically active, that this active area is very short in length, that this active length shortens further as the catalytic effectiveness of the pore surface increases, and that even with a surface of relatively low catalytic effectiveness such as smooth platinum, high current densities are attainable at reasonable voltages with proper electrode porosity. Author

N63-23458 Massachusetts Inst. of Tech., Cambridge School of Engineering
FUEL CELLS USING FLOODED FLOW ELECTRODES
H. P. Meissner and A. R. Reti *In its* Res. on Mater., Processes, and Devices Related to Energy Conversion May 31, 1963 14 p refs (See N63-23455 24-09)
(Contracts AF 33(616)-7642 and Nonr-1841(78); ARPA Order 214-62, Amend. 2)

As an alternative to porous gas-diffusion-type electrodes, a flooded porous electrode system comprising a bundle of silver or platinum screens is described. Appropriate reagents such as hydrogen or oxygen are dissolved in electrolyte in a suitable chamber, and this solution is then pumped through the wholly immersed electrode. Advantages in prospect are higher current densities, simpler electrode cooling, and no problems of interface control within the electrode. Offsetting disadvantages are the pumping power needed, the new control problems, and the added equipment needed. Author

N63-23459 Massachusetts Inst. of Tech., Cambridge School of Engineering
THE DEVELOPMENT OF THERMIONIC EMITTER MATERIALS
E. N. Carabateas, Arthur Shavit, R. Vanderweil, Jr., J. R. Bledsoe, P. Klimowski et al *In its* Res. on Mater. Processes and Devices Related to Energy Conversion May 31, 1963 p 35-60 refs (See N63-23455 24-09)

Progress reported is as follows: (1) The analytical tools for the study of the behavior of cesium films on metallic electrodes have been further developed by the methods of thermodynamics and statistical mechanics. An equation-of-state for the film was derived, with certain assumptions, from basic principles and was based on the importance and limitations of correlating and extrapolating experimental data in terms of the ratio of the surface temperature to the bath temperature. This analysis has been further extended, and the relation of the expression for the spreading force, or the two-dimensional equation-of-state of the surface, to the expression relating coverage, cesium bath temperature and surface temperature, or the three-dimensional equation-of-state, has been clarified. The minimum in work function has been obtained as the result of the opposite polarization of the adsorbed neutral atoms in the field of the adsorbed ions. (2) A cesium thermionic converter with a variable spacing and variable emitter (a monocrystal molybdenum emitter) has been constructed. The converter has a rhenium collector. I.v.L.

N63-23493 Aberdeen Proving Ground, Md.
JAVELIN DOVAP ANTENNA SYSTEM
R. Pinamonti and C. Wilson Aug. 1963 19 p
(BRL-TN-1511)

This report describes the preliminary attempts to develop a DOVAP (Doppler Velocity and Position) antenna system for the Argo D-4 or Javelin sounding rocket. The method of constructing the system, and the technique of mounting the elements to the exterior surface of a fiberglass rocket motor case, are presented. Descriptions of the static firing tests, and the conclusions drawn from the results of these tests are given. Author

N63-23507 Sylvania Electronic Systems, Waltham, Mass. Applied Research Lab.
HYDROMAGNETIC WAVE PROPAGATION IN A CONSTANT DIPOLE MAGNETIC FIELD Final Report
May 1, 1962 36 p 24 refs
(NASA Contract NASr-18)
(NASA CR-51994) OTS: $3.60 ph, $1.28 mf

Some formal apparatus of nonlinear theory is presented. The analog of Clebsch's transformation of the hydrodynamical equations allows a useful representation for the magnetic field; this representation leads in turn to some canonical equations for the motion of magnetic field of great theoretical interest. A theorem of decomposition of the magnetic field similar to the Cauchy-Stokes decomposition theorem in hydrodynamics is also presented. The report also deals with hydromagnetic wave propagation in (1) a constant and uniform magnetic field, and (2) in a constant dipole. Author

N63-23515 Hughes Research Labs., Malibu, Calif.
RESEARCH ON MILLIMETER-WAVE TUBES Interim Engineering Report No. 2, 1 July-30 Sept. 1963
D. C. Forster, J. F. Heney, O. P. Judd, and K. Amboss [1963] 57 p 3 refs
(Contract AF 33(657)-11116)

The continuing program to build a 100 w CW tube amplifier at W-band is described. A feasibility study of a 5-mm amplifier which eventually will deliver 30 w of CW power at 2mm is discussed. A 20-kv low-gain experimental amplifier using the short-fingered interdigital (SFID) slow-wave structure was built and tested at 5 mm. Extensive studies of the Model 75 electron gun which is designed for the eventual amplifier were carried out in the magnetic, demountable beam tester. Author

N63-23518 Cutler-Hammer, Inc., Deer Park, N.Y.
PERFORMANCE AND REQUIREMENT ANALYSIS OF VIDEO DECODERS FOR USE WITH ATC RADAR BEACON SYSTEM
Allan Ashley and Lanier G. Cole Jan. 1963 228 p 146 refs
(Contract FAA/BRD-329)

The study, essentially analytical, views the decoder from a functional standpoint in the performance of the overall system rather than as a piece of hardware. An extensive list of conclusions and recommendations is presented as a guide for system and component design. Related topics are also presented. Author

N63-23551 Tyco Labs., Inc., Waltham, Mass.
RESEARCH RELATING TO FUEL CELLS HYDROGEN DIFFUSION ELECTRODE Quarterly Progress Report No. 1, Covering Period through Dec. 31, 1962
A. C. Makrides Jan. 1963 48 p 50 refs
(Contract DA-49-186-ORD-982)

Rates of hydrogen transport through Pd and Pd–Ag membranes were measured as a function of hydrogen pressure, temperature, and surface preparation. Permeation rates were determined with one side of the membrane exposed either to vacuum or to an electrolyte. The room-temperature permeation rate of hydrogen through Pd–Ag alloys depends critically on the activity of the membrane surface. The permeation rate for smooth Pd membranes is of the order of 10^{-9} cc (NTP)/cm^2/sec. It increases by a factor of 10^5 when a coat of Pd black is deposited on the surface. The transport rate through a palladized, 0.04-mm-thick, 20% Ag–Pd membrane is 2×10^{-3} cc (NTP)/cm^2/sec at 30° C. The equivalent current density for hydrogen oxidation in an electrolytic cell in which hydrogen is supplied by solid-state diffusion through a Pd–Ag electrode is 20 ma/cm^2. An analysis of potentiostatic transients shows that the permeation rate through palladized membranes is still limited by the kinetics of adsorption and solution at the gas–membrane interface. Author

N63-23566 Army Electronics Research and Development Activity, White Sands Missile Range, N.M.
CIRCULATION DISTURBANCES BETWEEN 25 AND 70 KM ASSOCIATED WITH THE SUDDEN WARMING OF 1963
James E. Morris and Bruce T. Miers Oct. 1963 23 p 7 refs (ERDA-76)

Time-height cross sections constructed from meteorological rocket data were studied to determine the time and height extent of the sudden warming over several stations. Circulation changes were evident at subtropical as well as subpolar stations. Wallops Island data indicated that the major region of warm air moved east and north of the station. There were indications that the warming extended above 50 km, and that its maximum intensity was near 40 km. Circulation features observed near 30 km were found to retain their identity above 50 km. Author

N63-23575 Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
AN ANALYSIS AND SYNTHESIS PROCEDURE FOR FEEDBACK FM SYSTEMS. PART A: CONVENTIONAL FM SYSTEMS. PART B: FEEDBACK FM SYSTEMS
Andrzej Wojnar Sept. 30, 1963 53 p 31 refs
(Contracts DA-36-039-SC-78108 and DA-SIG-36-039-61-G14)

An investigation of frequency-compressive feedback FM systems has been made, with emphasis placed on threshold behavior. Following a survey of the existing noise analysis of FM systems, it is shown that the excess-noise component predominates in the threshold region of most conventional FM systems. A new analytical expression (which agrees with experimental evidence) has been found for the location of the noise threshold. Two possible mechanisms causing noise threshold in a feedback FM system are examined. Some modified formulas for feedback FM system performance at threshold are proposed; new bounds on the performance of the systems with optimum feedback filters are derived. The maximum obtainable threshold power-bandwidth tradeoff implied thereby is also determined. Experimental results with certain feedback FM configurations are reported. Author

N63-23578 Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
EXPLANATORY NOTES ON THE USE OF SINGULAR INTEGRAL EQUATIONS IN THE SOLUTION OF WAVEGUIDE DISCONTINUITY PROBLEMS
L. Lewin June 26, 1963 19 p refs
(Contract AF 19(604)-7499)
(PIB-MRJ-1175-63; AFCRL-63-315)

Notes on a singular integral-equation technique, which unifies several previous techniques for determining the effect of discontinuities in waveguide and permits the solution of new classes of discontinuities, are presented. These notes, which are intended to accompany several reference works on the subject, cover the following topics: (1) mode analysis of waveguide obstacles; (2) the nature of the kernel of the integral equation; (3) the expression of the integral equation in singular form; (4) the solution of the singular integral equations; (5) some properties of singular integral equations; (6) junctions between inhomogeneous waveguides; (7) the preparation of the singular integral kernel; and (8) the applicability of the technique. M.P.G.

N63-23595 Queensland U. (Australia)
MAGNETIC TAPE RECORDING AT VERY SLOW TAPE SPEEDS Technical Report No. 2
J. S. Mainstone, R. W. E. Mc Nicol, and D. R. Horgan Sept. 1962 26 p 1 ref
(Contract AFOSR-61-96)
(AFCRL-62-706)

An account is given of tape decks especially developed for the recording of geomagnetic micropulsations at stations operated by the Physics Department of the University of Queensland. Problems concerned with the construction of suitable recorders and methods of testing for optimum operating condition are considered. Also, one method of frequency-spectrum analysis of micropulsations recorded on slowly moving magnetic tape is discussed. I.v.L.

N63-23606 Joint Publications Research Service, Washington, D.C.
INTERNAL OSCILLATIONS OF 3-DIMENSIONAL RESONATORS WITH GRATE PARTITION
P. L. Kapitsa Oct. 23, 1963 27 p Transl. into ENGLISH of part of a book "Elektronika Bol'shykh Moshchnostey", 1962 p 159–194
(JPRS-21550; OTS-63-31987) OTS: $0.75

A theoretical study of the internal oscillations of a rectangular resonant cavity, enclosing (parallel to one pair of walls) a grating formed by periodically placed parallel rods with a rectangular cross section, is discussed. The presence of the lattice can be taken into account with the aid of a limiting boundary condition which includes the capacitance between the grating rods per unit rod length, provided that the grating period and thickness are small in comparison with the wavelength and the cavity dimensions. Also, an analogous study was conducted for a cylindrical (or coaxial cavity) containing a cylinder grate-type partition consisting of rods parallel to the axis of the cylinder. The oscillations of such a cavity in the presence of solid radial partitions are considered, and a resonator of complex form similar to the resonator of a multichamber magnetron was obtained. I.v.L.

N63-23624 Bolt, Beranek and Newman Inc., Cambridge, Mass.
RANDOM VIBRATION STUDIES OF COUPLED STRUCTURES IN ELECTRONIC EQUIPMENTS, VOLUME II
Denis U. Noiseux, Charles W. Dietrich, Ewald Eichler and Richard H. Lyon Oct. 1963 103 p refs
(Contract AF 33(657)-9118)
(Rept. No. 1061; ASD-TDR-63-205)

Two main areas are studied: the replacement of acoustic excitation by direct mechanical excitation, and the response of substructures tied to a randomly vibrating primary structure. This report presents techniques of measurement of power flow from a shaker to a structure, a detail analysis of the case of edge connections, the results of mechanical simulation of an

acoustic test applied to a model electronic package, and a discussion of acoustic and vibration tests performed on an Atlas Guidance Computer. Author

N63-23640 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
ON THE POSSIBILITY OF EVALUATING ULTRAHIGH VACUUM WITH THE AID OF AN EMISSION MICROSCOPE
Wojciech Lenkow and Czeslaw Workowski May 22, 1963 6 p refs Transl. into ENGLISH from Przeglad Elektroniki (Poland), v. 3, no. 11, 1962 p 646-648
(FTD-TT-63-377/1+2)

The possibility of reducing the time of adsorbing gaseous residues on a tungsten emitter of a Mueller microscope, by the application of electric sorption phenomenon, is discussed. The mechanism of this phenomenon appears to depend on electric sorption of positive polarized ions by the field of atoms and particles on the purified surface of the emitter. A 700-fold reduction in adsorption time has been obtained with an emission current of 10^{-4} amp, which allows evaluation of pressures of the magnitude of 10^{-11} Tr within a time less than 100 sec. P.V.E.

N63-23641 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
FIVE COMPONENT ELECTRIC AERODYNAMIC BALANCES
A. P. Biryulin, Ye. I. Karulin and A. G. Lysyakov May 28, 1963 6 p Transl. into ENGLISH from Russian Patent 135345 (649975/27), Jan. 5, 1960, 1961 p 1-3
(FTD-TT-63-379/1+2)

Electric aerodynamic balances have been invented for circular investigations of airplane models, including elastic elements with tenso-labels. However, these devices do not measure the angle-of-attack ranges exceeding 90°, and it is necessary to remove the airplane model and prepare it again for investigation. A description is given of five component electric aerodynamic balances of variable ranges in which the mentioned deficiency is eliminated by using various rigidity tenso-rings and mounting them on different arams. This method was found to assure broad ranges of measurement of values of aerodynamic forces and moments. Therefore, the experiment is expedited, and processing of the obtained experimental data is facilitated. R.T.K.

N63-23642 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
FORCED OSCILLATIONS IN AN ELECTRICAL CIRCUIT WITH A NONLINEAR CAPACITOR
V. N. Detinko and A. S. Petrov May 21, 1963 15 p refs Transl. into ENGLISH from Izv. Vyshikh Uchebn. Zavedeniy Fiz. (Tomsk), no. 6, 1962 p 90-98
(FTD-TT-63-476/1+2+4)

The amplifying properties on an oscillatory system with a nonlinear capacitor, excited by two sources of harmonic oscillations with clearly discernable frequencies, are examined. The examination indicates the presence of two mechanisms of signal amplification in all operating conditions of the circuit. The first of these relates to the fact that the oscillation frequency of the signal source is significantly less than the pumping frequency. This indicates that a nonlinear capacitance, changing its value under the influence of a low-frequency signal, modulates the high-frequency output flux to a useful load, whereas the power consumption of the signal is almost absent. The second mechanism is associated with the fact that, due to the interaction across the nonlinear capacitance between the voltages of two clearly discriminated frequencies, regeneration of the low-frequency circuit takes place. A regenerative amplification appears, the value of which depends on the pumping voltage across the nonlinear capacitance. P.V.E.

N63-23643 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
IMPROVING THE INTERFERENCE PROTECTION OF RADIO RECEPTION OF AM-SIGNALS BY EMPLOYING NONLINEAR FEEDBACKS IN THE HIGH FREQUENCY PART OF RECEIVING INSTALLATION
A. A. Gorbachev May 9, 1963 11 p refs Transl. into ENGLISH from Radiotekhnika (USSR), v. 18, no. 2, 1963 p 37-42
(FTD-TT-63-447/1+2)

A method of suppressing pulse interferences, based on the use of threshold feedbacks in the high-frequency part of the receiving installation, is explained. Experimental testing of the method was accomplished with the aid of a direct amplification receiver, assuring reception of radio broadcasting stations. The results indicate that nonlinear negative feedbacks in high frequency receiver cascades can be used for effective suppression of interferences. R.T.K.

N63-23650 Connecticut U., Storrs
THE DIRECT METHOD OF LIAPUNOV APPLIED TO THE DESIGN OF CONTROLLERS FOR A CLASS OF NONLINEAR AND TIME VARYING PROCESSES
Richard V. Monopoli Aug. 29, 1963 30 p 4 refs
(NASA Grant NsG-309-63)
(NASA CR-52239) OTS: $2.60 ph, $1.10 mf

The criterion of asymptotic stability is applied to the equation for the error between the process output and a desired output obtained from a model reference. A control signal generated on the basis of the error continually forces the process output to approach the desired output. The design procedure is developed for processes containing a single, time varying, nonlinear gain element, as well as linear time varying parameters. Restrictions on the nonlinear function are derived. Author

N63-23661 Rome Air Development Center, Griffiss AFB, N.Y.
TRANSISTOR FAILURE DIAGNOSIS
Ivars Irbe Aug. 1963 29 p 4 refs
(RADC-RAS-TM-63-5)

A number of transistors of several types which had failed during the life tests of various Preferred Solid-State Circuits have been investigated to determine the causes of their failures. Faults in manufacturing processes, device design, and incorrect usage of the device were among the causes of failure. Author

N63-23690 Illinois U., Urbana Antenna Lab.
WIDE-BAND CORRUGATED SURFACE ANTENNA
Marvin Lee Wahl June 1963 39 p 11 refs
(Contract AF 33(657)-10474)
(Tech. Rept.-71)

The basic principles for antennas of LP (log-periodic) design are discussed and applied to synthesizing a flush-mounted LP antenna which has been named the letter-rack antenna. It is shown why a simple corrugated surface is not suitable for broadband antenna design. A composite system consisting of a series of alternately transposed loops and a corrugated surface was constructed such that the two periodic systems couple strongly to each other. The behavior of the coupled system was investigated on the basis of coupled-mode theory, and the significance of the k-β diagram to the LP antenna design is outlined. P.V.E.

N63-23698 Army Missile Command, Huntsville, Ala. Research and Development Directorate

SOLID STATE CIRCUIT TECHNIQUES: DC SWITCHING DEVICES

Max E. Massengill June 1, 1963 19 p
(RG-TR-63-14)

In the study, two devices were used as a switch: a silicon-controlled rectifier (SCR) and a trinistor-controlled rectifier with gate turnoff. The SCR can be turned on by a signal on the gate; however, additional circuitry is necessary to turn it off. The best results were obtained by using a circuit that connects a charged capacitor across the SCR, back-biasing it until it recovers its ability to block forward voltage. The trinistor-controlled rectifier with gate turnoff used as a static switch is discussed. Tests were conducted to determine the device voltage drop, minimum gate voltage and current to fire, minimum gate voltage and current to turn off, and effect of overloading the device. Author

N63-23737 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.

PULSE MAGNETIC DECODER

I. V. Lebedev May 22, 1963 5 p Transl. into ENGLISH from Russian Patent 145064 (695956/26), Feb. 1, 1961, 1962 p 1-3
(FTD-TT-63-459/1+2)

A pulse magnetic decoder on two cores, each of which has two input and one output windings, is proposed in order to increase efficiency and lower the level of interferences. The input windings are connected with each other and with two paraphase inputs in accordance with logic formulas of decoding. All the cores are linked together in a series by the general connection winding. R.T.K.

N63-23739 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.

A PHOTOSERVOSYSTEM

R.I. Polonnikov Jan. 25, 1963 6 p Transl. into ENGLISH from Russian Patent 140226 (683412/26), Oct. 25, 1960
(FTD-TT-62-1528/1+2+4)

A photoservosystem for training telescopes is described. It uses an analyzing pyramid, located in the focal plane of the telescope, in order to increase efficiency and simplify the design of the system. The analyzing pyramid directs the luminous flux from a star to four photoelements, connected in pairs, that are supplied by atomic batteries; for periodic correction of the entire system, an opaque gate with a radioluminescent standard, a gate that blocks out the luminous flux, is installed and a feedback circuit is introduced. R.T.K.

N63-23740 Rome Air Development Center, Griffiss AFB, N.Y.

THE ELECTRICAL EQUIVALENT CIRCUIT OF AN EL PANEL
Technical Memorandum

Robert P. Burns Oct. 1963 20 p refs
(RADC-RAS-TM-63-6)

An in-house experimental program was established to obtain data on the electrical and optical parameters of field effect electroluminescent (EL) panels. The behavior of a typical EL panel is described in graphical form, and the results used to postulate an electrical equivalent circuit of the typical panel. A correlation was then made between the equations which were empirically derived and those obtained theoretically. Author

N63-23767 Air Force Systems Command, Wright-Patterson AFB, Ohio

SERVOSYSTEMS WITH SPHERICAL-COORDINATE CONVERTERS BASED ON ROTARY TRANSFORMERS

V. P. Yegorov Dec. 5, 1962 18 p refs Transl. into ENGLISH from Sbornik Rabor Voprosam Elektromiekhan. (Moscow), 1961 p 162-176
(FTD-TT-62-1194/1+2+4)

The development of dome drive systems (for use in the coordination of telescope and dome movement) with spherical-coordinate converters (CC) based on rotary transformers (RT) is discussed. Results of full-scale tests of the system showed that the system provides a satisfactory degree of accuracy in solving the problem $A = f(t, \delta)$ and $z = f T (t, \delta)$. The system is efficient in any operating regime, both in the driving regime as well as in the aiming regime, in any observed region of the celestial dome, including the region of the zenith. P.V.E.

N63-23778 Martin Co., Baltimore, Md.

OPTIMUM APERTURE STUDY

H. B. Mc Clung Rome Air Develop. Center, Griffiss AFB, N.Y., Aug. 1963 47 p
(Contract AF 30(602)-2676)
(RM 225; RADC-TDR-62-334)

The objective of this contract is to study the applicability of the Wiener-Spencer theorem to antennas. This theorem states that minimum standard deviation of the far-field power pattern occurs when the illumination function corresponds to the lowest mode of vibration of a membrane stretched across the aperture opening. This quarterly report reviews the first phase of this study in which various representative distributions and far-field power patterns for a linear and a square antenna are considered. A comparison of these distributions and the optimum distribution as determined by the Wiener-Spencer theorem is made. In addition, a survey is made of the known geometrical configurations in which Helmholtz's equation is separable. Author

N63-23815 Purdue U., Lafayette, Ind.

OPTIMUM NONLINEAR CONTROL OF A SYSTEM WITH TWO INPUTS AND ONE OUTPUT

Kiyohisa Okamura (Ph. D. Thesis) June 1963 56 p refs
(NASA Grant NsG-28-59)
(NASA CR-52226) OTS: $5.60 ph, $1.88 mf

This thesis proposes the extension of Oldenburger's approach to optimum nonlinear control of single variable systems to that of a simple class of multivariable systems. The class next in complication to single input-single output systems may be the one where the system has two inputs and one output. This class may be treated as a single input-single output system except where one of the inputs and the time derivative of the other are bounded. This class of systems is to be optimized such that the time duration of the transient is minimized, as well as the maximum over or under swing, etc. After the transient vanishes, both inputs are to be brought to their reference values as quickly as possible. A controller is designed which yields an optimum transient. The controller uses a check-decision process which does not arise in a single input-single output system. Author

10 FACILITIES

Includes: airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations.

For related information see: 06 Auxiliary Systems.

N63-23012 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
WIND TUNNEL FACILITIES AT THE JET PROPULSION LABORATORY
George G. Goranson, Robert E. Covey et al. Jan. 1, 1962 57 p 2 refs
(NASA Contract NAS7-100)
(NASA CR-51851; JPL Tech. Release 34-257) OTS: $5.60 ph, $1.91 mf

Wind-tunnel facilities are described as follows: (1) operating conditions, (2) nozzle calibration, (3) model suspension systems, and (4) test instrumentation. R.T.K.

N63-23103 University of Southern Calif. Engineering Center, Los Angeles
INVESTIGATION OF LIQUIFIED GAS PRESSURE SOURCES FOR BLOWDOWN WIND TUNNEL
D. A. Wallace June 24, 1963 10 p
(USCEC 65-57)

The feasibility of operating hypersonic blowdown wind tunnels, using a two-phase gas supply, was investigated. The approach was to use a liquified gas supply, a high-pressure liquid pump, and a vaporizer to provide the high-pressure gas. The investigation was carried out by operating two wind-tunnel configurations at Mach 7.5, using a liquid-nitrogen gas supply. Conclusions reached as a result of the investigation were: (1) the two-phase gas supply system is satisfactory for the operation of hypersonic wind tunnels; (2) the LN_2 system is approximately two orders of magnitude more expensive than a conventional compressor gas supply; and (3) a cost tradeoff analysis on the basis of initial capital investment and tunnel-utilization factors would be required by a particular facility to determine the desirability of using the two-phase supply system. P.V.E.

N63-23654 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
COMPARISON OF CALCULATED WITH MEASURED BOUNDARY-LAYER THICKNESSES ON THE CURVED WALLS OF THE JPL 20-IN. SUPERSONIC WIND TUNNEL TWO-DIMENSIONAL NOZZLE
Bain Dayman, Jr. Mar. 18, 1963 29 p 15 refs
(NASA Contract NAS7-100)
(NASA CR-52252; JPL-IR-32-349) OTS: $2.60 ph, $1.06 mf

Experimentally determined values of the local skin-friction coefficients of adiabatic flat-plate, turbulent, compressible boundary layers were approximated by an analytical expression which, in turn, was used in conjunction with the boundary-layer integral-momentum equation to calculate test-section boundary-layer thicknesses. These calculations were compared with measured boundary-layer thicknesses for the Mach number range of 1.4 to 5. These comparisons were fair, but varied as the Reynolds number was varied. The use of a simpler, analytical boundary-layer skin-friction equation gave better comparisons and was not as dependent upon Reynolds number as the less simple analytical expression. Author

N63-23728 Air Force Systems Command Wright-Patterson AFB, Ohio Foreign Tech. Div.
STREAM CONTROL FOR LOW SPEED RANGE IN WIDE TUNNEL
Zdzislaw Brodzki Nov. 30, 1962 30 p refs Transl. into ENGLISH from Tech. Lotnicza (Poland), nos. 1–2 and 3–4, 1961 p 12–15 and 44–47
(FTD-TT-62-1476/1+2)

Problems associated with the building and with the phenomena occurring in wind tunnels, including the following, are discussed: (1) the pulsation field in free streams in the measuring space of a wind tunnel, (2) fields of pressure pulsation in the closed section of a wind tunnel, (3) frequency and intensity of pulsations, (4) analysis of pulsation phenomenon, (5) distributions of static pressures and velocities, and (6) pulsation dampers. P.V.E.

N63-23747 Aeronautical Research Council (Gt. Brit.)
THE PRESSURE CALIBRATION OF THE R.A.E. 6 INCH DIAMETER SHOCK TUBE WITH A VIEW TO ITS USE AS THE DRIVER OF A COLD HIGH-DENSITY HYPERSONIC TUNNEL
S. G. Cox, R. J. Pallant, and J. M. Shaw London, HMSO, Apr. 1963 25 p 4 refs
(ARC-C.P. NO. 698; previously issued as RAE-TN-AERO 2894; ARC 24722) Available from HMSO: 5s

This note describes a systematic investigation of the pressure fields produced within the R.A.E. 6-inch shock tube at low shock speeds. This work was undertaken to investigate the tube's suitability as the driver of a cold high-density hypersonic tunnel. It is concluded that the tube is suitable and should produce expanded flows at Mach numbers up to 15. Author

11 FLUID MECHANICS

Includes: boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow, 03 Aerodynamics of Wings and Control Surfaces; 13 Heat Transfer; and 24 Physics, Plasma.

N63-23008 Avco-Everett Research Lab., Everett, Mass.
KRAMERS' AND LINE RADIATION FROM NITROGEN AND AIR SHOCKS
R. A. Allen, R. L. Taylor and A. Textoris May 1963 23 p 16 refs
(NASA Contract NAS9-858; Contracts AF 04(694)-33 and DA-19-020-ORD-5476; Proj. Defender)
(NASA CR-51850; AMP 113; BSD-TDR-63-102) OTS: $2.60 ph, $0.89 mf

Radiation data are presented which have been obtained from both the nonequilibrium and equilibrium regions behind normal shocks in the velocity range from 7 to 12 mm/μsec using the recently developed electric arc-driven shock tube. Atomic line radiation is found to be a prominent feature of both the nonequilibrium and equilibrium regions of strong air and nitrogen shocks at wavelengths longer than 0.6μ. For the higher end of this velocity range, molecular band radiation from air is negligible compared to the continuum radiation produced by the capture and the deceleration of electrons (Kramers' radiation). Farther in the infrared from 2 to 6μ, radiation measurements have been made behind reflected

shocks in air and nitrogen at equilibrium temperatures 6000° to 9000° K. This continuum radiation is interpreted as due to free-free scattering of electrons from neutral atoms and molecules. Author

N63-23009 Massachusetts Inst. of Tech., Cambridge Aeroelastic and Structures Research Lab.
THE EFFECT OF FREE STREAM TURBULENCE AND VORTICITY ON THE RADIATIVE SOUND FIELD OF A FREE JET
Robert D. Smith Aug. 1963 78 p 10 refs
(NASA Grant NsG-31-60)
(NASA CR-51985; ASRL-TR-1013) OTS: $7.60 ph, $2.54 mf

This work has, as its objective, the experimental examination of the changes which occur in the rms amplitude and the power spectral density of the radiative sound field of a round free jet of 0.5 in. diam. with the following velocity fields imposed at the jet nozzle exit: (1) a vortex pair, (2) free-stream turbulence, (3) a vortex pair and free-stream turbulence, (4) turbulent wakes containing a Karman vortex street with 3.0 kc and 5.7 kc as frequencies of vortex emission. Most of the tests were made for a jet nozzle exit Mach number of 0.8 with the rms amplitude and far field power spectra measured in the frequency range from 0.5 kc to 15.0 kc. Author

N63-23059 Brandeis U., Waltham, Mass.
THEORETICAL STUDIES OF IONIZED GASES Final Report
Eugene P. Gross Aug. 30, 1963 5 p refs
(Contract AF 19(604)-4553)
(AFCRL-63-322)

Publications are listed which explore methods of solving the many-body problem. Attention is focused on the classical plasma problem and the quantum boson problem. R.T.K.

N63-23080 Iowa Inst. of Hydraulic Research, Iowa City
TECHNIQUE OF DETERMINING THE VISCOUS DRAG OF A SHIP MODEL BY MEANS OF A WAKE SURVEY Final Report
Jin Wu Aug. 1963 37 p 9 refs

The evaluation of the validity and the accuracy of the various viscous-drag formulas of Landweber, Wu, and Jin; an investigation as to the influence of turbulence in the wake; and a study of the feasibility of a practical, routine technique for making viscous-drag measurements are discussed. I.v.L.

N63-23086 Avco Corp., Wilmington, Mass. Research and Advanced Development Div.
NONEQUILIBRIUM WAKES WITH LAMINAR AND TURBULENT TRANSPORT
Hwachii Lien, John I. Erdos, and Adrian J. Pallone [1963] 65 p 34 refs
(Contract AF 04(694)-239)
(Preprint No. 63-447)

The problem of the wake of a reentry vehicle is briefly reviewed, and an analysis is formulated for the solution of the nonsimilar, nonequilibrium viscous-flow equations, with laminar and turbulent transport. Numerical results are presented for the wake of 15 feet, 8° (half-angle) cone, at 22,000 feet per second, for altitudes of 150,000 feet and 115,000 feet. Author

N63-23096 Avco-Everett Research Lab., Everett, Mass.
MEASUREMENTS OF THE GROWTH AND SYMMETRY OF THE LUMINOUS HYPERSONIC WAKE BEHIND BLUNT BODIES
R. L. Taylor, B. W. Melcher II, and W. K. Washburn May 1963 40 p 26 refs
(Contracts AF 04(694)-33 and DA-19-020-ORD-5476; Proj. Defender)
(Avco-Everett Res. Rept. 163; BSD-TDR-63-108)

Measurements of the width of luminous wakes behind hypervelocity blunt bodies launched in ballistic ranges are presented. Experiments utilizing an image converter camera, a race track drum camera and a photoelectric wake scanner have obtained data over 1200 body diameters of wake length on 0.22-, 0.55-, and 1.0-inch spherical projectiles for free-stream pressures from p_∞ = 0.2 to 10.0 cm Hg and projectile velocities from V_∞ = 12,000 to 20,500 fps. The experimental techniques are discussed briefly, typical raw and reduced data are shown, and the consistency of the three types of data is established. Author

N63-23134 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
EXPERIMENTAL STUDY OF HIGH SPEED HYDROFOILS, VOLUME III
H. R. Wright Aug. 26, 1963 51 p
(Contract NObs-84454)
(XAR-A-45)

This test program was conducted to measure the hydrodynamic characteristics of a series of supercavitating and transcavitating hydrofoil models with various planforms and sections, to provide a design procedure to predict hydrodynamic characteristics for this type hydrofoil. Twenty hydrofoil models were tested in a whirling tank at three depths, and at a sufficient number of speeds and angles-of-attack to fully define their hydrodynamic characteristics. Lift, drag, pitching moment, and strut base pressure were measured for all models, and cavity pressure and foil base pressure were measured for the supercavitating models. Author

N63-23143 Harry Diamond Labs., Washington, D.C.
FLUID AMPLIFICATION. II: STAGING OF PROPORTIONAL AND BISTABLE FLUID AMPLIFIERS
Silas Katz and Robert J. Dockery Aug. 30, 1963 52 p 4 refs
(TR-1165)

The generalized performance characteristics are examined in detail for both proportional and bistable (digital) fluid amplifiers with no moving parts. An approach leading to the solution of fluid systems design problems is given. Equations describing the pressure and flow variations are developed. Typical performance curves are drawn showing performance trends with several variables manipulated. Experimental curves are presented confirming the theoretical approach. A typical proportional unit, with principal dimensions, is shown with its characteristic curves. Author

N63-23183 Polytechnic Inst. of Brooklyn, N.Y.
AXIALLY SYMMETRIC HETEROGENEOUS MIXING
Antonio Ferri Sept. 1963 43 p 17 refs
(Grant AF-AFOSR-1-63)
(PIBAL-787; AFOSR-5326)

Heterogeneous mixing is considered. Numerical methods are used to investigate the importance of simplifying assumptions usually introduced in the analysis of laminar mixing. Experiments on turbulent mixing are analyzed in order to obtain information on turbulent transport properties. Author

N63-23333 Canadian Armament Research and Development Establishment, Valcartier
AN EXAMINATION OF THE USE OF ABSORPTION SPECTROSCOPY IN THE STUDY OF WAKES
J. L. Patenaude and C. M. Sadowski Aug. 1963 18 p 13 refs
(ARPA Order 133)
(CARDE TR-465)

This report considers absorption spectroscopy in a variety of spectral regions as a possible technique for the study of uncontaminated wakes behind hypersonic projectiles. On the basis of arguments presented from the standpoint of the expected thermodynamic, chemical, and spectroscopic properties of the wake, and also from the standpoint of experimental requirements which cannot be fulfilled at the present, it was concluded that measurements would have to be confined to the vacuum ultraviolet spectral region. Even here the data would be restricted to the establishment of a 300° K isotherm, and to an otherwise strictly qualitative knowledge of the absorption properties of the wake, because of the highly overlapped nature of the absorption spectrum expected at wake temperatures. Author

N63-23358 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN INVESTIGATION OF THE VIBRATION CHARACTERISTICS OF PRESSURIZED THIN-WALLED CIRCULAR CYLINDERS PARTLY FILLED WITH LIQUID
John S. Mixson and Robert W. Herr 1962 39 p refs Previously processed as a thesis; for abstract see N62-13600 10-32
(NASA TR R-145) GPO: $0.45

Equations are derived for the calculation of the natural frequencies of shell vibration of pressurized, thin-walled, circular cylinders which are empty, partly filled, or full of liquid. In this type of vibration the axis of the cylinder is undeformed and the cross-section shape deforms during the vibration. The derivation follows a Rayleigh–Lagrange procedure, in which expressions for kinetic and potential energy are developed in terms of the displacements of the cylinder, the displacement shapes are assumed, and Lagrange's equations are applied to give a set of linear, simultaneous equations of motion which, upon substitution of simple harmonic motion, yield a frequency determinant. Both calculated and experimental results show that when the cylinders are greater than half full, their frequencies are less than half of the corresponding frequencies of cylinders when empty. Also, the damping of a water-filled cylinder was found experimentally to be less than the damping of the empty cylinder. Author

N63-23371 Atomic Energy Research Establishment, Harwell (Gt. Brit.)
PRODUCTION OF VACUUM BY CONDENSATION ON LOW-TEMPERATURE SURFACES I. CRYOGENIC PUMPS
G. Klipping and W. Mascher Repr. from Vakuum-Tech. (Berlin), v. 11, no. 3, 1962 p 81–85 14 refs
(AERE TRANS-915)

The article deals with the physical principles on which the production of vacuum by condensation of gases on low-temperature surfaces is based. The facilities for making available the required cooling media on a commercial scale are surveyed. This leads to the basic conceptions which guide the design and operation of cryogenic pumps. Author

N63-23381 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STUDY OF THE FLOW IN THE CHANNELS OF AXIAL-FLOW IMPULSE FANS
Jerzy Konrad Nowakowski Aug. 29, 1963 5 refs Transl. into ENGLISH from Prace Inst. Tech. Cieplanej (Poland), v. 9, no. 16, 1961 p 33–56
(FTD-TT-63-71/1+2)

Seven flow channels are designed on the basis of Herzog's theoretical method for axial-flow impulse fans having various diameter ratios in the end section, and the lines of flow in them are plotted. The velocity fields in the channels are studied by means of a pitot-static tube, the boundary layer at the walls being taken into account. To determine the flow symmetry, study is made of the static pressure distribution on the surface of one of the hubs in two zones of flow. The results of the experiments are compared with theoretical calculations. Author

N63-23387 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
HEAT TRANSFER AND RESISTANCE OF SLOTTED CHANNELS WITH OVAL CONICAL STAMPINGS
I. G. Pedorov Aug. 22, 1963 12 p 7 refs Transl. into ENGLISH from Izv. Vysshikh Ucheb. Zavedeniy, Aviats. Tech. (USSR), no. 4, 1962 p 145–150
(FTD-TT-63-617/1+2+4)

The results of studies of heating surfaces used on plate heat exchangers with conical stampings having an elongated oval form in the plane are presented in tabular and graphic form. Criteria, with respect to heat transfer and resistance, for channels with oval stampings in both staggered and unstaggered configurations are discussed. It is concluded that the heat transfer in bi-angle and right-angle channels with unstaggered configuration of oval stampings almost coincide. Heat-transfer coefficients in channels with circular conical stampings are 20% higher, on the average, than in channels with oval stampings, indicating that these forms of stampings—circular conical—are evidently more favorable for the intensification of heat transfer. P.V.E.

N63-23410 Maryland U., College Park, Md.
FORMAL KINETIC THEORY OF TRANSPORT PHENOMENA IN POLYATOMIC GAS MIXTURES
K. S. Yun, E. A. Mason and L. Monchick (APL) Repr. from J. Chem. Phys. v. 39, no. 3, Aug. 1963 p 654-669 42 refs
(NASA Grant NsG-5-59)

A rigorous, formal kinetic theory of multicomponent, polyatomic gas mixtures is derived. The calculations correspond to the first approximation in the classical Chapman–Enskog theory. Expressions are derived for the coefficients of shear viscosity, volume viscosity (which is proportional to a relaxation time), ordinary diffusion, translational and internal thermal conductivity, and thermal diffusion. Although the results are rather formal, a number of useful conclusions about the effects of inelastic collisions can be drawn without the necessity of detailed calculations. Author

N63-23435 Pennsylvania State U., University Park Coll. of Engineering
A STUDY OF THE EFFECT OF CURVATURE ON TURBULENT FLOW Final Report
David P. Margolis Sept. 1963 141 p 20 refs
(Grant DA-ARO-(D)-31-124-G196)
(AROD-3227-1)

The problem is the theoretical and experimental investigation of a curved turbulent mixing layer. An understanding of the turbulent mechanism is desired when the flow is subjected to a centripetal acceleration field. It was found that the presence of a radial gradient of angular momentum which is either positive or negative causes the mixing layer flow to be dynamically either stable or unstable. In the stable case the mean motion of the layer is like a periodic wave motion with increasing amplitude and wave length. The greatest insight into the effect of the centripetal acceleration field can be obtained from the turbulent energy balances. Author

N63-23505 California U., Los Angeles. Aerosonics Lab.
EXPERIMENTS ON THE CONTROL OF PLANE JETS BY AUXILIARY FLOWS
Josef Wuere July 1963 53 p 22 refs
(Rept. 63-31)

Steady deflection characteristics for several jet geometries are discussed and illustrated by photographs. For a single control jet system, flow measurements show a linear relationship between the momenta of the two interacting jets for constant angles of deflection. For two symmetrically placed control jets, it is found that there exists a particular setback of the jet housings where control flow requirements are minimum. The problem of deflection past a wedge centered in the power jet stream is also considered. Author

N63-23511 Southwest Research Inst., San Antonio, Tex.
MEASUREMENTS OF LIQUID DAMPING PROVIDED BY RING BAFFLES IN CYLINDRICAL TANKS Technical Report No. 5
Luis R. Garza and H. Norman Abramson Apr. 1, 1963 26 p 3 refs
(NASA Contract NAS8-1555; SwRI Proj. No. 6-1072-2)
(NASA CR-52070) OTS: $2.60 ph, $0.98 mf

Measured data on the damping effectiveness of flat ring baffles in partially filled cylindrical tanks is presented in considerable detail. Particular emphasis is placed on the effects of baffle perforation. Author

N63-23573 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
CHEMICAL NON-EQUILIBRIUM SHOCK FLOW
V. A. Langelo Aug. 1963 53 p 7 refs
(Contract AF 04(647)-617)
(R63SD66)

The purpose of this report is to discuss the problem of calculating the flow behind a normal shock front. The additional complication of finite reaction rate chemistry has been included. A numerical method and several results of flow across a shock wave with an eleven species, thirteen reaction model of air are presented. Author

N63-23605 Joint Publications Research Service, Washington, D.C.
CRYSTAL GROWTH AND THE BOUNDARY LAYER
Gyulai Zoltan (Hungary) Oct. 10, 1963 32 p refs Transl. into ENGLISH from Fiz. Szemle (Budapest), no. 5, May 1963 p 131-143
(JPRS-21398; OTS-63-31910) OTS: $1.00

Zoltan Gyulai's work in crystal growth is discussed. He established the fact that the rules given by the Kossel theory are in agreement with the observable growth mechanism. This is particularly interesting because these rules seem to apply to measurements of higher orders of magnitude than the ion measurements figuring in the theory. Here then, something more than theory must be involved. This "something more" led to the formulation of Gyulai's theory of the transitional boundary layer. In connection with investigations of crystal nucleus formation, taking place in solutions, Gyulai observed that under certain conditions many fine-needled crystals are formed. These appear very suddenly, which seems to confirm the theory of the transitional boundary layer. The tensile strength of the needle crystals often exceeded the ideal tensile strength of large monocrystals. I.v.L.

N63-23611 ARO, Inc., Arnold Air Force Station, Tenn.
PROPERTIES OF SPHERICAL STRESS WAVES PRODUCED BY HYPERVELOCITY IMPACT
Ray Kinslow (Tenn. Polytechnic Inst.) Oct. 1963 52 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-197)

A semi-empirical model is derived which will contribute to the understanding of the nature of waves and fractures in solids caused by hypervelocity impact. The distance within a solid at which the shock wave slows down to an elastic wave is considered as the radius of a "cavity" to the surface of which a forcing function can be applied to produce an elastic wave similar to that produced by the impact of a high-velocity projectile. By the use of a high-speed computer, the characteristics of the forcing function are found which will produce the same effects as those caused by a projectile. This forcing function can be described by a mathematical series, each term being of a form for which the general wave equation can be solved. This permits the computation of particle displacement, particle velocity, and principal stresses within the target. Author

N63-23645 Giannini Controls Corp., Malvern, Pa.
RESEARCH STUDIES IN PROPORTIONAL FLUID STATE CONTROL COMPONENTS
H. A. Curtiss and D. J. Liquornik Sept. 3, 1963 81 p 37 refs
(Contract DA-36-034-ORD-3722-RD)
(ARD-TR-013-01)

The Double Leg Elbow Amplifier (DLEA) can provide a linear, repeatable differential mass flow gain of over 220:1, and is not seriously affected by large changes in supply flow level or element size, or by moderate changes in the output loading. The dynamic performance of the DLEA is well within usual control system requirements, and its Single Elbow Amplifier variant is capable of operation at frequencies at least as high as 1.2 kc. Fourier analysis of the DLEA transient test data resulted in good agreement with measured harmonic response behavior. Author

N63-23660 Applied Physics Lab., Silver Spring, Md.
TASK R, QUARTERLY PROGRESS REPORT NO. 18, 1 JULY-30 SEPT. 1963
A. A. Westenberg [1963] 40 p refs
(Contract NOw-62-0604-c; ARPA Order 22-63)
(SR 4-2)

Progress is reported on: dissociated-gas studies where consideration has been given of the possibilities of microwave saturation in the electron-spin resonance studies of gas-phase atoms, resulting in the observation of saturation in N-N_2 and H-H_2; molecular-beam chemical kinetic studies wherein several beam chopping devices were tried and their characteristics assessed; and rocket-nozzle fluid dynamics which included *in situ* measurement of actual CO_2 concentrations in the rocket exhaust. C.L.W.

N63-23672 Purdue U. Lafayette, Ind.
HYDRAULIC LINE DYNAMICS
Rufus Oldenburger and Raymond Eugene Goodson [1963] 39 p refs
(NASA Grant NsG-28-59)
(NASA CR-52148) OTS: $3.60 ph, $1.37 mf

The hydraulic line between two cross sections is characterized by a four-terminal network with pressure and rate of flow the interacting variables. Use of this network leads to transcendental transfer functions that are not suited to the computation of system transients. The standard technique of power series expansions fails in that this yields instability in most applications where this instability does not actually occur. These difficulties are overcome by the use of infinite products. Only a few factors of these products are needed to

compute transients to engineering precision. The accuracy of the approximation can be seen from the factors directly. The technique applies to electrical transmission lines as well as hydraulic. Author

N63-23746 Aeronautical Research Council (Gt. Brit.)
A NOTE ON THE USE OF END PLATES TO PREVENT THREE-DIMENSIONAL FLOW AT THE ENDS OF BLUFF CYLINDERS
C. F. Cowdrey London, HMSO, June 1962 14 p 2 refs
(ARC-CP NO. 683; previously issued as NPL-AERO 1025; ARC-23907) Available from HMSO: 3s

The results are given of some observations of the effects of end plates on the three-dimensional separated flow at the ends of cylindrical models. While these are by no means exhaustive, it is felt that they are of sufficient interest to merit putting on record. Author

N63-23784 Harry Diamond Labs., Washington, D.C.
THE STAGNATION-POINT LANGMUIR PROBE IN A SHOCK TUBE – THEORY AND MEASUREMENTS
Irvin Pollin (Ph.D. Thesis) June 28, 1963 93 p 29 refs
(TR-1103)

A model of the ion-electron flow in the stagnation region between the detached shock and the wall of a Langmuir-type probe is proposed for ionized air in a shock tube at ion mass fractions less than 10^{-4}. Based on the close agreement between numerical calculations and measurements of the probe-wall ion-current density, the proposed model gives an accurate description of the ion-electron flow in the stagnation-point boundary layer when negative potentials are applied at the stagnation point of the probe. The procedure is indicated to be applicable also in the region between the detached probe shock and the edge of the boundary layer. The ion and electron densities in the boundary layer are shown to be strongly dependent on the equilibrium conditions for the high-temperature gas behind the shock. Author

12 GEOPHYSICS

Includes: auroral phenomena; upper atmospheric studies; cartography; geodesy; and geomagnetism.

For Van Allen belts see: 28 Space Radiation.

For related information see: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N63-23024 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC SURVEY DATA AVAILABLE PRIOR TO THE WORLD MAGNETIC SURVEY EFFORT OF THE IQSY
S. Hendricks and J. C. Cain 31 p 4 refs
(NASA TM X-50956; NASA-X-611-63-12) OTS: $3.60 ph, $1.13 mf

The distributions of magnetic survey information available from all sources since 1900 are given. The data are tallied according to distribution by area and decade, and according to component measured. Recommendations are made on the basis of these studies for specific surveys during the IQSY. Author

N63-23087 Michigan U., Ann Arbor Inst. of Science and Tech.
MEASUREMENTS OF NEAR AND REGIONAL EARTHQUAKES OUTSIDE THE CONTINENTAL UNITED STATES
John M. Denoyer, David E. Willis, and James T. Wilson Oct. 1963 61 p 4 refs
(Contracts AF 19(604)-8809 and AF 49(638)-1170; ARPA Order 180-62, Amend. 8; Proj. Vela Uniform)
(Rept. 4618-11-F/5178-18-T; AFCRL-63-850)

A field-measurement program was conducted in a number of areas outside the continential limits of the United States as a part of a research study on the propagation of seismic waves generated by earthquakes. These measurements were made in Chile, Crete, Hawaii, American Samoa, Pakistan, and Puerto Rico. Over 250 earthquakes, as detected by short-period three-component seismometers, were recorded on FM magnetic tape recorders. Except in Crete and American Samoa, the earthquakes recorded at epicentral distances less than several hundred kilometers generally contained a significant amount of seismic energy above 10 cps. In some instances the earthquakes contained no low-frequency energy that would be detected by standard seismograph station short-period instruments. In most cases the shear-surface waves had amplitudes larger than the compressional waves. This amplitude relationship was more pronounced for horizontal component recordings than for the vertical component. Author

N63-23092 Ohio State U. Research Foundation, Columbus
PRACTICAL COMPUTATION OF GRAVITY AT HIGH ALTITUDES
R. A. Hirvonen and Helmut Moritz May 1963 95 p 12 refs
(Contract AF 19(628)-2771)
(Rept. 27; AFCRL-63-702)

This report presents and compares methods for computing the gravity vector outside the earth. The gravity vector is split up into a normal part, the vector of normal gravity, and an anomalous part, the vector of gravity disturbance. The components of the gravity vector are first computed in a local coordinate system and then transformed to the geocentric world system by a spatial rotation. If the gravity vector is required along a rocket trajectory, then also the components along and normal to the trajectory can be computed by a spatial rotation. The standard errors of the components of the gravity disturbances, due to the interpolation of the gravity material, are, approximately, inversely proportional to the elevation and very small for high altitudes, provided there is uniform coverage by gravity stations. The influence of the distant zones is considered in some detail. This influence decreases very slowly beyond a certain radius, so that it is impractical to go farther than about 30° in the direct method and 20° in the coating method (with an error of about ±5 mgal in both cases), unless the integration is extended over the whole earth, which is necessary for higher accuracy. Author

N63-23093 Uppsala U. (Sweden)
RESEARCHES OF WHISTLER PHENOMENA Final Report, 1 Aug. 1957-31 Mar. 1963
Harold Norinder [1963] 8 p 11 refs
(Contract AF 61(052)-07)
(AFCRL-63-714)

Analysis was carried out of relations between lightning discharges and musical atmospherics of the usual whistler type and of unusual forms. Recording cathode-ray oscillographs were used for analysis of the relations. Cathode-ray oscillographic direction finders placed at two stations at suitable distances allowed determination of the sources of the lightning discharges in relation to musical atmospherics. Author

N63-23113 Chicago U., Ill.
STUDY OF THE LARGE-SCALE CIRCULATION OF THE EARTH'S ATMOSPHERE Final Report

Frank B. Lipps Aug. 1963 42 p refs
(Contract AF 19(604)-7266)
(AFCRL-63-872)

This report contains a reprint of a paper "Stability of jets in a divergent barotropic fluid," by Frank B. Lipps, and summaries of two other studies by Lipps: "Stability of an asymmetric basic flow in a barotropic fluid," and "Momentum transfer due to unstable quasi-geostrophic disturbances." The report also includes an abstract of "Some characteristic features of winter circulation in the troposphere and lower stratosphere," by K. Miyakoda. Author

N63-23127 Conservation Foundation, New York, N.Y.
IMPLICATIONS OF RISING CARBON DIOXIDE CONTENT OF THE ATMOSPHERE
Noel Eichhorn [1963] 18 p

A review of an interdisciplinary conference which discussed the biological, geographical, and economic consequences of the rise of atmospheric carbon dioxide due to the burning of fossil fuels is presented. Although much exact knowledge of the carbon cycle of the earth remains to be determined, general agreement exists that the continuing rise of atmospheric carbon dioxide is likely to be accompanied by a significant warming of the surface of the earth. The melting polar icecaps would raise sea level, perhaps to the point of inundating large low-lying land masses, and the warming of the oceans would considerably change the distribution of marine species. The buffering biogeochemical processes, which have been adequate in the past, seem unlikely to be capable of compensating for changes of such magnitude. The most promising solution to the problem seems to lie in the development of new sources of power. M.P.G.

N63-23140 Joint Publications Research Service, Washington, D.C.
TERRESTRIAL MAGNETISM
Sh. Dolginov Oct. 18, 1963 Transl. into ENGLISH from Aviats. i Kosmonaut. (Moscow), no. 7, July 1963 p 26–32
(JPRS-21493; OTS-63-31959) OTS: $0.50

A discussion of the earth's magnetic fields, the patterns of their distribution, and the changes occurring in them is presented. Both the main and variable magnetic fields are considered. J.E.T.

N63-23142 Joint Publications Research Service, Washington, D.C.
WORK IN ANTARCTICA
Ye. I. Tolstikov Oct. 21, 1963 11 p Transl. into ENGLISH from Vestnik Akad. Nauk SSSR (Moscow), no. 5, May 1963 p 79–82
(JPRS-21531; OTS-63-31978) OTS: $0.50

The exploits and accomplishments of Soviet scientists at Soviet stations in Antarctica are discussed, along with proposals to expand the scope of experimental activity by these scientists. Atmospheric phenomena were observed at the South Geomagnetic and South Geographic Poles, and a new cold pole of the planet earth was discovered in the region of the VOSTOK station. Observations of satellites are being carried out, regular monitoring of radio signals is being performed, the signals of ground radio stations are being recorded, and the intensity of the field of the radio stations is being measured. The proposed geophysical program for the Soviet Antarctic stations includes observation of geomagnetism, aurorae and night-airglow, the ionosphere, solar activity, cosmic radiation, and space studies. C.L.W.

N63-23176 Lockheed Aircraft Corp., Burbank, Calif.
NUCLEAR REACTORS AND EARTHQUAKES
T. H. Thomas et al Washington, AEC Div. of Tech. Inform., Aug. 1963 428 p refs Work performed jointly with Holmes and Narver, Inc.
(TID-7024) OTS: $5.00

The purpose of this report is to supply pertinent seismological information to engineers in the nuclear-reactor field. Included are historical data on earthquake occurrence, intensity, and wave shapes. Also, some techniques for evaluating the response of structures to such events are included. A brief discussion of certain reactor types and modes of operation is presented to provide architectural, structural, and mechanical engineers with an insight into the design requirements of the nuclear-reactor industry. I.v.L.

N63-23302 Air Force Cambridge Research Labs., Bedford, Mass.
GEODETIC APPLICATIONS IN THE SPACE AGE
Owen W. Williams *In its* Compendium of Papers in the Fields of Geodesy and Planetary Geometry Aug. 1963 8 p Lecture prepared for Forum Ser. on Space Sci. for VOA, USIA, Jan. 1962 (See N63-23301 24-01)

New developments in the theory and practice of geodesy have been made feasible through the utilization of technological developments such as specialized optical and electronic acquisition and tracking systems, high-intensity stroboscopic lights and pyrotechnic flash cartridges, accurate continuous wave and pulse radio measuring and navigation systems, precise radio-timing systems having global range, etc. Precise electronic surveying and controlled photographic techniques are exemplified by the airborne Shoran (a pulsed distance measuring system) and Hiran (high precision Shoran) systems. The use of well-designed and well-planned geodetic satellites, rocket-flash triangulation methods, and airborne gravity surveying are examples of technological developments which can be used to obtain uniform geodetic coverage of high accuracy in excess of 1 part in 100,000. P.V.E.

N63-23306 Air Force Cambridge Research Labs., Bedford, Mass.
THREE DIMENSIONAL GEODESY AND AN EARTH-CENTERED COORDINATE SYSTEM
Owen W. Williams *In its* Compendium of Papers in the Fields of Geodesy and Planetary Geometry Aug. 1963 12 p Presented at the Ital. Geodetic Comm. Symp. on Geodesy in Three Dimensions, Cortina d'Ampezzo, Italy, May 1962 (See N63-23301 24-01)

The space age has generated a universal need for a geocentric geodetic coordinate system whereby all datums may be related to the center of the earth's mass. The three-dimensional capabilities and contributions of rocket-flash triangulation, satellite geodesy, and airborne gravimetry are discussed, since they will provide positional accuracies considerably better than one part in 100,000 in relation to this system. A description of the techniques, past and future experiments, numerous applications, and problem areas are presented. Author

N63-23308 Air Force Cambridge Research Labs., Bedford, Mass.
ANNA: A FLASHING SATELLITE
Michael S. Tavenner *In its* Compendium of Papers in the Fields of Geodesy and Planetary Geometry Aug. 1963 10 p refs Presented at the ACSM-ASP Conv., St. Louis, Mo., Sept. 1962 (See N63-23301 24-01)

A discussion is made of the present Project ANNA (geodetic satellite) program. This discussion includes technical considerations of light intensities, power, and camera requirements. Also, a description of field operations, data handling, and functions of the participating agencies is included. Author

N63-23309 Air Force Cambridge Research Labs., Bedford, Mass.
GEODESY'S NEWEST DIMENSION
Lyndon I. Sheldon *In its* Compendium of Papers in the Fields of Geodesy and Planetary Geometry Aug. 1963 13 p refs Presented at the ACSM-ASP Conv., St. Louis, Mo., Sept. 1962 (See N63-23301 24-01)

Many methods and projects of three-dimensional geodesy have a common denominator—the photographing of a light source against a star background. Tested methods are rocket-flash triangulation and long-line azimuth determination. The geodetic satellite ANNA is an example of a system whose observation program is just beginning. A proposed program which is now under study is Project SCORPIO, a satellite system primarily designed to calibrate range instrumentation equipment but which will also provide geodetic and geophysical data. LARGOS, a laser-activated reflecting geodetic optical satellite, also in the design stage, will be a passive-type satellite. Undergoing feasibility studies is a geodetic, equatorial, synchronous satellite, which could provide valuable information on gravitational harmonics. Author

N63-23310 Air Force Cambridge Research Labs., Bedford, Mass.
GEODESY: PROMISE AND PROGRESS
Owen W. Williams *In its* Compendium of Papers in the Fields of Geodesy and Planetary Geometry Aug. 1963 12 p Presented at the Inaugural Meeting of the Earth Sci. Technol. Assoc., Framingham, Mass., Sept. 26, 1962 (See N63-23301 24-01)

In the space age, geodesy is to provide the extremely accurate parameters of the size, shape, and mass distribution of the world. In the immediate future, these stringent requirements will be met by the use of optical and electronic techniques including rocket-flash triangulation, HIRAN-SHIRAN, satellite geodesy, airborne gravity meter, and many other methods. Author

N63-23313 Air Force Cambridge Research Labs., Bedford, Mass.
PRELIMINARY REPORT ON THE OPTICAL SYSTEM FOR THE ANNA GEODETIC SATELLITE
Owen W. Williams and Armando Mancini *In its* Compendium of Papers in the Fields of Geodesy and Planetary Geometry Aug. 1963 18 p Presented at the 2nd Western Natl. Meeting of the Amer. Geophys. Union, Stanford, Calif., Dec. 27, 1962 (See N63-23301 24-01)

A general report will be made on the optical observations of the ANNA geodetic satellite. This will include a description of the optical system, photographic image sizes, test observations to check the strobe light and magnetic orientation of the satellite, possible geodetic ties for Bermuda, and current status of the optical program. Author

N63-23334 RAND Corp., Santa Monica, Calif.
THREE PAPERS ON RADIATIVE TRANSFER FROM "INVESTIGATIONS OF THE PHYSICS OF THE ATMOSPHERE," NO. 3, ACADEMY OF SCIENCES, ESTONIAN S. S. R., 1962
Yu. Mullamaa, O. Avaste, H. Moldau, and K. S. Schifrin Sept. 1963 110 p 73 refs
(Contract AF 49(638)-700)
(RM-3869-PR)

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II. THE SPECTRAL DISTRIBUTION OF DIRECT AND DIFFUSE RADIATION O. Avaste, H. Moldau, and K. S. Schifrin p 23–82 25 refs (See N63-23336 24-12)

III. AN APPROXIMATE SOLUTION TO THE PROBLEM OF RADIATIVE TRANSFER IN THE CASE OF ANISOTROPIC SCATTERING O. Avaste p 83–97 11 refs (See N63-23337 24-12)

N63-23335 RAND Corp., Santa Monica, Calif.
THE DIFFUSE REFLECTION AND TRANSMISSION OF LIGHT BY TWO ISOTROPIC MEDIA SEPARATED BY A ROUGH SURFACE
Yu. Mullamaa *In its* Three Papers on Radiative Transfer from "Invest. of the Phys. of the Atmosphere," No. 3, Acad. of Sci., Eston. S. S. R., 1962 Sept. 1963 p 1–21 32 refs (See N63-23334 24-12)

It is assumed that a surface consists of elements whose normals are distributed in space according to definite laws. Equations have been formulated for calculating the intensity of diffusely reflected and transmitted light, taking into account the polarization both of a narrow incident beam and of diffuse incident radiation. Author

N63-23336 RAND Corp., Santa Monica, Calif.
THE SPECTRAL DISTRIBUTION OF DIRECT AND DIFFUSE RADIATION
O. Avaste, H. Moldau, and K. S. Schifrin *In its* Three Papers on Radiative Transfer from "Invest. of the Phys. of the Atmosphere," No. 3, Acad. of Sci., Eston. S. S. R., 1962 Sept. 1963 p 23–82 25 refs (See N63-23334 24-12)

The results of calculations of the spectral distribution of direct and scattered radiation are given for various conditions of atmospheric turbidity, with regard to the absorption of water vapor, carbon dioxide, and ozone. Calculations for a standard radiation model of the atmosphere agree nicely with average experimental data. An approximate equation is proposed for calculating the influence of the surface albedo on an incident flux of scattered radiation when true absorption is present. Author

N63-23337 RAND Corp., Santa Monica, Calif.
AN APPROXIMATE SOLUTION TO THE PROBLEM OF RADIATIVE TRANSFER IN THE CASE OF ANISOTROPIC SCATTERING
O. Avaste *In its* Three Papers on Radiative Transfer from "Invest. of the Phys. of the Atmosphere," No. 3, Acad. of Sci., Eston. S. S. R., 1962 Sept. 1963 p 83–97 11 refs (See N63-23334 24-12)

Several questions regarding the accuracy of the Sobolev approximate method are discussed. Shown to be possible is an improved accuracy for the approximate solutions to the problem of radiative transfer in the case of anisotropic scattering. Corrected equations are introduced for the downward flux of scattered radiation. At the same time, the component due to secondary scattering is separated out, and its dependence on the azimuth is taken into consideration. Multiple scattering is evaluated using a spherical scattering function. Author

N63-23366 Innsbruck U. (Austria)
HORIZONTAL MAGNETIC DIPOLE AT THE DEPTH H UNDER THE EARTH'S SURFACE CALCULATION OF THE RADIATION FIELD BY THE INTEGRAL METHOD Technical Note No. 4
G. Tinhofer Aug. 10, 1963 17 p
(Contract AF 61(052)-490)
(AFCRL-63-384)

The radiation field of a horizontal magnetic dipole located within the conducting earth under a plane earth–air interface is calculated by the Sommerfeld integral method. The representation is valid for the far field. Field strengths are calculated for $k/k_E < 10^{-1}$. Author

N63-23415 Defense Research Telecommunications Establishment, Ottawa (Canada)
TOPSIDE SOUNDING OF THE IONOSPHERE
J. H. Chapman *In* Amer. Astron. Soc. Scientific Satellites 1963 p 41–63 (See N63-23412 24-01)

The topside sounding method of study of the ionosphere is described in principle, and the sweep-frequency and fixed-frequency methods are discussed. The major part of the paper is concerned with the Alouette Topside Sounder satellite (S-27), 1962 Beta Alpha one. A description is given of the spacecraft and typical topside ionograms are shown. Author

N63-23416 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE NASA TOPSIDE SOUNDER PROGRAM
L. J. Blumle, R. J. Fitzenreiter, and J. E. Jackson *In* Amer. Astron. Soc. Scientific Satellites 1963 p 65–95 refs (See N63-23412 24-01)

The topside sounder program is reviewed with particular emphasis upon the fixed-frequency topside-sounder satellite, S-48. The design of the S-48 satellite is compared with that of the Alouette, the recently launched Canadian swept-frequency topside sounder. This comparison reveals the complementary features of their scientific objectives, as well as basic differences in the technology used to accomplish these objectives. Author

N63-23441 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEOMAGNETISM
James P. Heppner *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 83–97 (See N63-23436 24-01)
(Lecture 6)

The electromagnetic environment of the earth is discussed. The magnetic field is seen to be the controlling factor at great altitudes; the gravitational field acts as the controlling factor near the earth; and the interaction of the two fields assumes importance in the ionosphere. The problem of predicting the behavior of the magnetic field and the ionospheric charged particles is shown to be further complicated by the fact that the gravitational field is relatively unaffected by solar radiations, whereas the magnetic field reacts strongly to solar emission. The very existence of the geomagnetic field is related to a complex coupling between the motion of the conducting fluid core of the earth and the magnetic fields produced in the fluid. The use of rockets, satellites, and space probes in mapping the geomagnetic field is discussed. The total geomagnetic field is considered as the product of the slow variations in the field due to the earth's core and the rapid variations due to the ionized gases and energetic particles in the space surrounding the earth. The magnetic waves which result from the interaction of the geomagnetic field with the interplanetary magnetic field are also discussed. M.P.G.

N63-23442 National Bureau of Standards, Boulder, Colo.
THE IONOSPHERE
Alan H. Shapley *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 99–110 (See N63-23436 24-01)
(Lecture 7)

A review of the structure of the ionosphere and the processes which are active in the various ionospheric layers is presented. Rocket experiments and theoretical analyses show that sunlight in the far ultraviolet and X-ray part of the spectrum is primarily responsible for the ionospheric layers. The balance between the production, movement, and loss of electrons in the D region, E layer, and F region is outlined, and the effects of these layers on practical radio communication is discussed. Variations in the ionosphere are measured by radars operating at selected radiofrequencies and other ground-based techniques, supplemented by satellites for sounding the topside of the ionosphere. Certain peculiarities of ionospheric propagation, such as whistlers and ducts, are also discussed. M.P.G.

N63-23443 Yerkes Observatory, Williams Bay, Wis.
THE AURORA
Joseph W. Chamberlain *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 111–122 (See N63-23436 24-01)
(Lecture 8)

The historical trend of speculation on the nature and origin of the aurora is reviewed, and some promising recent developments relating to the problem of auroral formative processes are discussed. None of the theories are considered to give a satisfactory explanation of all the observed phenomena. However, progress in plasma physics theory coupled with satellite experiments should decide whether the aurora arises from the dumping of trapped particles or from the direct entry of solar plasma into the earth's atmosphere. Besides resolving the problem of the origin of aurora, satellite and space probe experiments are expected to contribute to knowledge of physical conditions in the high atmosphere and, hopefully, of planetary aurorae. M.P.G.

N63-23445 Wisconsin U., Madison Geophysics and Polar Res. Center
RESEARCH IN GEODESY
George P. Woollard *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 139–155 (See N63-23436 24-01)
(Lecture 10)

Advances in geodesy as a result of satellite orbital observations are reviewed, and specific recommendations are made for a special geodetic survey. The basic relationships between geodesy and gravity, the nature of gravity as a force field, and the effect of the earth's gravity field on a satellite are discussed. Studies of the orbital perturbations of satellites have proven invaluable in resolving previous discrepancies related to the overall oblateness of the earth but have also raised new questions. A coordinated geodetic study is suggested, involving analysis of global gravity measurements, extension of electronic distance measurements, integrated analysis of the orbits of several satellites with different inclinations, and launch of a spherical geodetic satellite into a high circular orbit. The instrumentation and tracking requirements of this satellite are discussed. Such a satellite should yield data on the gravity field and size and shape of the earth, on the distances between existing geodetic datums and isolated triangulation networks in different parts of the world, and on the strength and motions of the interior of the earth. M.P.G.

N63-23540 Carnegie Institution of Washington, D.C.
EXPERIMENTAL GEOPHYSICS
B. F. Burke and M. A. Tuve *In its* Annual Rept. of the Director of the Dept. of Terrest. Magnetism, 1961–1962 Dec. 10, 1962 p 214–239 refs (See N63-23539 24-01)

Work carried out in experimental geophysics is reported in the following areas: (1) radioastronomy—radiohydrogen observations and continuum observations; and (2) the earth's crust—seismic studies and radioactive ages of rocks. P.V.E.

N63-23541 Carnegie Institution of Washington, D.C.
THEORETICAL AND STATISTICAL GEOPHYSICS
S. E. Forbush *In its* Annual Rept. of the Director of the Dept. of Terrest. Magnetism, 1961–1962 Dec. 10, 1962 p 239–241 refs (See N63-23539 24-01)

Studies in theoretical and statistical geophysics include the following: (1) morphology and temporal variations of the intensity of charged particles in the Van Allen trapped-radiation belt—an investigation to determine how the temporal changes of intensity and morphology in the trapped-radiation belt are related to geomagnetic variations; a particular objective was to determine whether temporal variations of intensity in the belt might be responsible for variations in the geomagnetic field of the equatorial ring current responsible for geomagnetic storm-time changes; and (2) measurements of the geomagnetic equatorial ring current, and the latitude of auroral currents. P.V.E.

N63-23549 Joint Publications Research Service, Washington, D.C.
STUDIES IN THE PHYSICS OF THE UPPER ATMOSPHERE
N. I. Fedorova *In its* Sov. Atmospheric and Marine Res. Oct. 11, 1963 p 17–20 Transl. into ENGLISH from Vestnik Akad. Nauk SSSR (Moscow), no. 8, 1963 p 113–115 (See N63-23547 24-01)

A discussion is given concerning the study of the most pressing problems in the elementary processes and photochemistry of the upper atmosphere, the measurement of geoactive corpuscles, the physics of the radioactive zones of the earth, and polar phenomena. C.L.W.

N63-23572 Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
ATOMIC COLLISION PROCESSES RELATING TO THE IONOSPHERE Annual Summary Report, Oct. 1, 1962-Sept. 30, 1963
A. V. Phelps et al [1963] 5 p refs
(Contract Nonr-2584(00); ARPA Order 125-62 (Amd. 7); Proj. Defender)

Progress reported is as follows: (1) Resonance in the elastic scattering of electrons is 3% of the elastic cross section. (2) A search for such a resonance in atomic hydrogen was undertaken, stimulated by theoretical prediction that such a resonance should exist around 9.6 ev. To date, this resonance has not been determined experimentally. (3) The work on vibrational excitation of molecular hydrogen has been completed. (4) The characteristic energy and the magnetic drift velocity were calculated for electrons in argon and hydrogen–argon mixtures. (5) Measurements of the electron drift velocity in cesium–argon mixtures. (5) Measurements of the electron drift velocity in cesium–argon mixtures gave the cross section for electron excitation of cesium atoms near the threshold of excitation. Measurements of the Townsend α coefficient are now being made to give the behavior of the excitation function at higher energies. I.v.L.

N63-23627 Queensland U., Brisbane (Australia)
EQUIPMENT FOR THE RECORDING ON PAPER CHART OF GEOMAGNETIC MICROPULSATIONS Technical Report No. 1
J. S. Mainstone, R. W. E. Mc Nicol, D. R. Horgan, and R. S. Fitchew Sept. 1962 58 p refs
(Contract AF-AFOSR 61-96)
(AFCRL-62-705)

Pickup of geomagnetic micropulsations and telluric micropulsations has been attempted. For pickup of geomagnetic micropulsations, a portable pickup coil assembly is used. This consists of four or eight formers slipped over a high permeability core with a length of 1 meter and a diameter of 2 cm. Each former is wound with about 100,000 turns of double-insulated 36-B and S-gage copper wire, so that, when all are connected in series, there is a total of 400,000 or 800,000 turns in the coil. This gives a total effective area of the coils of either 0.75×10^5 m^2 or 1.5×10^5 m^2. For pickup of telluric micropulsations, earth-current probes made of sheets of lead (Pb), about 1/8 in. thick and about 6 ft long by 9 in. wide, loosely rolled into cylinders of about 3-in. diameter were inserted into holes bored into the ground. The hole is loosely filled with the finely divided earth taken from the hole, to within a few inches of the top, and is kept filled with water. P.V.E.

N63-23678 National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION TOPSIDE SOUNDER PROGRAM
L. J. Blumle, R. J. Fitzenreiter, and J. E. Jackson Washington, NASA, Nov. 1963 23 p refs
(NASA TN D-1913) OTS: $0.75

The Topside Sounder Program is reviewed with particular emphasis upon the fixed-frequency topside sounder satellite. A comparison of the design of the *fixed*-frequency topside sounder with that of the Alouette (1962 $\beta\alpha$), the recent Canadian *swept*-frequency topside sounder, reveals the complementary features of their scientific objectives and the basic differences in the technologies employed. Author

N63-23688 University of Southern Calif., Los Angeles
A STUDY OF WINDBORNE SAND AND DUST IN DESERT AREAS
Thomas Clements, Richard O. Stone, John F. Mann, Jr., and James L. Eymann Mass., Army Natick Lab., Aug. 1963 70 p 13 refs
(ES-8)

During a storm, sand and dust in militarily significant amounts are carried a few miles at most, but generally only a few hundred or thousand feet. Wind-driven sand is carried mostly within 2 feet of the ground, with 6 feet as a maximum height in all but extremely high winds. Critical pickup velocities of winds vary according to the type of desert surface, the grain size and coherency of the surface materials, and whether or not the surface has been disturbed artificially. In dune areas, winds of 10 to 15 miles per hour will initiate movement, and on other sandy terrain, winds of 20 miles per hour will be necessary for this. Fine materials on desert flats will be set in motion at 20 to 25 miles per hour, and on alluvial fans and playas at 30 to 35 miles per hour. No windblown material will be derived from desert pavements unless the surface has been broken, and on all other above-mentioned types, disturbing the surface will lower critical pickup velocities by as much as 5 miles per hour. Author

N63-23695 Joint Publications Research Service, Washington, D.C.
UTILIZATION OF THE SUBSURFACE HEAT OF THE EARTH
V. A. Nurshanov (USSR) Oct. 31, 1963 8 p Transl. into ENGLISH from Gas. Prom. (Moscow), no. 8, 1963 p 52-53 (JPRS-21670; OTS-63-41037) OTS: $0.50

Plans for the utilization of thermal waters and terrestrial steam as sources of thermal energy for industrial purposes are discussed. I.v.L.

N63-23755 National Aeronautics and Space Administration, Washington, D.C.
LOWEST MEASURED TEMPERATURE IN EARTH'S ATMOSPHERE RECORDED IN US-SWEDEN EXPERIMENTS News Release No. 63-248
Nov. 4, 1963 4 p
Available from NASA. Office of Scientific and Technical Information, Wash., D.C.

Scientists at the University of Stockholm, Sweden, announced recording, by sounding rocket, of temperatures which are possibly the lowest ever measured in the earth's atmosphere. Temperatures as low as −143° C were computed in Swedish Lapland in scientific experiments jointly conducted by the Swedish Space Committee and the National Aeronautics and Space Administration. The experiments were made to study the behavior and nature of noctilucent clouds at altitudes up to 60 miles. P.V.E.

N63-23761 Weapons Research Establishment (Australia)
IONOSPHERIC DATA FOR JUNE, 1962 FROM WOOMERA, SOUTH AUSTRALIA
July 1963 23 p
(Rept. Ionospheric Data Bull. CPD 1962/6 (W))

A bulletin is given containing tabulations of ionospheric data for the month of June, 1962, obtained from a station at Woomera, South Australia, which was set up for observations associated with upper-atmosphere experiments. C.L.W.

N63-23762 Weapons Research Establishment (Australia)
IONOSPHERIC DATA FOR JULY, 1962 FROM WOOMERA, SOUTH AUSTRALIA
July 1963 23 p
(Rept. Ionospheric Data Bull. CPD 1962/7 (W))

Tables of the hourly values of the customary ionospheric parameters are given. Author

N63-23768 Air Force Systems Command, Wright-Patterson AFB, Ohio
PHOTOELECTRIC DEVICE FOR ESTABLISHING IDENTICALNESS OF TEXT AND ILLUSTRATION ORIGINALS, FOR EXAMPLE, GEOGRAPHICAL MAPS AND REPRODUCTIONS OF THE LATTER
D. N. Chekalov, M. A. Matveyeva et al Dec. 11, 1962 15 p Transl. into ENGLISH from Russian Patent 141502(660295/28), Mar. 28, 1960 p 1–9
(FTD-TT-62-1507/1+2)

A proposed device for establishing the identicality of originals and reproductions, for example, of geographic maps and their reproductions is described. This device consists of two photoelectric heads, a voltage modulator, an a.c. electron amplifier, a phase-sensitive circuit, an electron-comparator, and a system of light and sound signaling. The use of this device will eliminate the laborious visual process and heighten the precision of collation. I.v.L.

13 HEAT TRANSFER

Includes: ablation; cooling; heating; and other thermal effects.

For aerothermodynamics see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings and Control Surfaces.

For combustion see: 26 Propellants and Combustion.

For related information see: 11 Fluid Mechanics.

N63-23040 National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
APPARATUS FOR DETERMINING LOW TEMPERATURE THERMAL CONDUCTIVITY
C. F. Smith July 16, 1963 31 p 3 refs
(NASA TM X-50852; MTP-P&VE-M-63-9) OTS: $3.60 ph, $1.13 mf

Because of the need for low-temperature thermal-conductivity data on a wide variety of materials used in the space launch-vehicle field, an apparatus was developed for determining such information on metal over a temperature range of 80° to 225° K (−316° to −55° F). Data are presented for copper, stainless steel, and aluminum alloys, and compare favorably with values reported by other investigators on the same alloys. Author

N63-23076 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
HEAT TRANSFER OF A CYLINDER WITH FREE MOTION OF A GAS IN RAREFIED SPACE
A. K. Rebrov (Kazon Aviation Inst.) Jan. 17, 1962 16 p 3 refs Transl. into ENGLISH of a paper presented at the Heat Transfer Conf., Minsk, June 5–10, 1961 p 1–15
(FTD-TT-62-50/1+2+4)

The features of heat transfer of horizontal and vertical cylinders for the free motion of a rarefied gas in unbounded space, and when the walls of the housing exert an effect, were established. Criteria were found for calculating the heat transfer of horizontal cylinders in unbounded space for the range $GrPr = 10^{-7}$ to 10^{8}, and for the heat transfer of vertical cylinders in unbounded space for the range $GrPr = 10^{-4}$ to 10^{2}. A method was developed for the approximate estimation of heat transfer in regimes close to pure heat conduction. C.L.W.

N63-23132 Boeing Co., Seattle, Wash.
EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER TO COMPLEX AERODYNAMIC CONFIGURATIONS AT HYPERSONIC SPEEDS
Geroge C. Lorenz, Robert J. Sartell, and Sainsbury L. Strack Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Sept. 1963 78 p 2 refs
(Contract AF 33(657)-10033)
(ASD-TDR-63-530)

Tests with a heat-sensitive paint and ceramic models representative of an aerospaceplane were conducted. The purpose was to locate regions of severe heating, and to obtain an approximation of the heat flux through the use of calibration spheres. The magnitudes of the heat-transfer coefficients on the models were found to be measurable by this method within ±15%. It is concluded that this is an excellent technique for locating and measuring high fluxes, especially when used as a preliminary to conventional heat transfer and pressure-testing procedures. Author

N63-23185 General Electric Co., Valley Forge, Pa. Space Sciences Lab.
EXPERIMENTAL HEAT TRANSFER STUDIES OF HYPERVELOCITY FLIGHT IN PLANETARY ATMOSPHERES
J. S. Gruszczynski and W. R. Warren, Jr. N.Y., Am. Inst. of Aeron. and Astronautics [1963] 61 p 20 refs Presented at the AIAA Conf. on Phys. of Entry into Planetary Atmospheres, Cambridge, Mass., Aug. 26–28, 1963
(Supported by NASA; JPL Contract 950297)
(AIAA Paper 63-450) AIAA: $0.50 members, $1.00 nonmembers

Characteristics of aerothermodynamic conditions affecting a vehicle entering a planetary atmosphere are explored. Results

of flight simulation study of some of the heat transfer problems associated with the entry of a ballistic vehicle into the atmospheres of near planets are presented. The planetary atmospheres are assumed to be composed primarily of CO_2-N_2, and hypervelocity entry conditions are assumed. The percentage composition of the CO_2-N_2 does not have a large effect on the experimental convective heat transfer rates; and the percentage composition of the test gas is relatively much less important in the hypervelocity regime than in the earth orbital and suborbital velocity regimes. R.T.K.

N63-23186 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING UNSTEADY ONE-DIMENSIONAL GAS MOTION WITH HEAT INPUT IN A CHANNEL OF VARIABLE CROSS SECTION
N. N. Popov. 16 p. 2 refs. Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. I: Mat. i Mekhan. (Moscow), no. 2, Mar.–Apr. 1961 p 71–79
(FTD-TT-61-36/1+2+4)

A solution of problems of one-dimensional unsteady gas motion with heat input in a channel of variable cross section is discussed. The solution is expressed in terms of Bessel functions and contains an arbitrary number of constants. This paper presents two possible methods of determining these constants. The solution obtained using these methods can be easily programed for use on electronic computers. It has an essential advantage over the method of characteristics or method of networks in that it requires the fulfillment of certain conditions on the boundary of the region, after which it gives an analytical solution inside of this region, in contrast to the above-mentioned methods, which yield a solution only at isolated points. I.v.L.

N63-23315 Avco-Everett Research Lab., Everett, Mass.
HEATING PROBLEM FOR SUPERSATELLITE RE-ENTRY
Peter H. Rose. *In* Aeron. Systems Div. Proc. of Retardation and Recovery Symp., Dayton, Nov. 13–14, 1962 p 14–33 refs (See N63-23314 24-01)

The present state of research in the main sources of heating at supersatellite velocity is discussed. Various theories and experimental measurements of convective heat transfer of partially ionized air, as well as the present controversy about this phenomenon, are discussed. New data on the radiative properties of high-temperature air are interpreted in terms of the heat-transfer problem. The relative magnitude of these phenomena are evaluated in terms of typical reentry situations. Author

N63-23320 Directorate of Materials and Processes, Wright-Patterson AFB, Ohio. Aeronautical Systems Div.
HIGH TEMPERATURE FIBROUS MATERIALS FOR DECELERATORS
Jack H. Ross. *In* Aeron. Systems Div. Proc. of Retardation and Recovery Symp., Dayton, Nov. 13–14, 1962 p 215–233 refs (See N63-23314 24-01)

The successful use of recovery systems is dependent on advances in the state-of-the-art of fiberology—the forming of fibers and characterization of their behavior, and fabric geometry—the design of highly efficient flexible structures from yarn bundles and their characterization. This paper reviews that applied research which has been accomplished toward the achievement of fibers and flexible structures capable of operation over a broad temperature range. Author

N63-23342 Union Carbide Nuclear Co., Oak Ridge, Tenn.
TOSS: AN IBM-7090 CODE FOR COMPUTING TRANSIENT OR STEADY STATE TEMPERATURE DISTRIBUTIONS
David Bagwell. Dec. 1, 1961 79 p 2 refs
(Contract W-7405-eng-26)
(K-1494) OTS: $1.75

A program has been written, for the IBM-7090, which will solve the heat-transfer equations for the transient and/or steady-state temperature distribution of a three-dimensional irregular body using a first-forward difference method. Given the geometrical and physical description of the assembly, TØSS will give as output the temperature distribution as a function of time. Ease of input, clear and compact output, and efficient computation were the principal considerations in designing the code. Author

N63-23346 McGill U., Montreal (Canada). Arctic Meteorology Research Group
A MULTI-LEVEL STUDY OF HEAT TRANSPORT Scientific Report No. 7
Charles E. Hill. May 1963 57 p 24 refs
(Contract AF 19(604)-8431)
(*Its* Publ. in Meteorology 58; AFCRL-63-678)

The poleward transport of sensible heat by atmospheric waves is computed on a daily basis. Computations are made at every five degrees of latitude from 30° N to 80° N at 850, 700, 500, 300, 200, 100, and 25 mb. Fourier analysis is employed to determine the spectral distributions of heat transport. Intense cyclogenesis occurs during the period and significant changes are produced in both the spectral distributions and the total transports. Author

N63-23360 Michigan U., Ann Arbor. Coll. of Engineering
INVESTIGATION OF LIQUID METAL BOILING HEAT TRANSFER Preliminary Draft of Final Report
Richard E. Balzhiser, Robert E. Barry, C. Phillip Colver, Herman Merte, Jr., Andrew Padilla, Jr. et al. Wright-Patterson AFB, Ohio. Flight Accessories Lab., Oct. 1963 313 p refs
(Contract AF 33(616)-8277)

Liquid-metal boiling heat-transfer is reviewed. A study of saturated pool boiling of potassium in the nucleate regime has supported the nucleate boiling data of Bonilla and co-workers at Columbia University. Values of the critical heat flux were determined experimentally over a pressure range of 0.1 psia to 22 psia. The data fall substantially above the theoretical prediction of Zuber and Tribus, Rohsenow and Kutateladze. The critical heat-flux results are of the same magnitude as predicted by Noyes of Atomics International, based on his experimental work with sodium at the lower end of the above-mentioned pressure range. The slope of the burnout flux versus pressure curve is much flatter than was predicted by Noyes on the basis of his data and a modified version of the hydrodynamic "correlations." At atmospheric pressure, the burnout flux was found to be approximately 600,000 Btu/hr/ft^2. Significant temperature fluctuations were observed in the potassium pool during the course of these investigations. I.v.L.

N63-23365 Fabric Research Labs., Inc., Dedham, Mass.
MECHANICAL AND THERMAL DEGRADATION MECHANISMS OF QUARTZ FIBERS, AND THE DEVELOPMENT OF EXPERIMENTAL QUARTZ FABRICS WITH IMPROVED FINISHES
L. Barish, D. H. Powers, C. C. Chu, E. Cilley and E. R. Kazwell. Wright-Patterson AFB, Ohio. AF Materials Lab., Sept. 1963 151 p refs
(Contract AF 33(616)-7557)
(ASD-TDR-63-802)

This report is a summary of research on the utilization of quartz filament yarns for high-temperature parachute applications. One of the objectives is the study of the mechanism of

premature fiber damage. A second is the development of finishes which will protect the quartz and maintain, at ambient temperatures, its tenacity throughout yarn and fabric manufacturing and subsequent parachute assembly processes, as well as at elevated temperatures during and after deployment. One of the promising finishes developed in this program is the chelate formed by the reaction of aluminum isopropoxide and 8-hydroxy quinoline. A yarn treated with this compound gives a room-temperature strength of 220,000 psi or 7.84 grams per denier; 103,000 psi or 3.81 grams per denier at 1200° F; and 53,000 psi or 1.88 grams per denier at 1800° F. Author

N63-23367 Chance Vought Corp., Dallas, Tex
DEVELOPMENT OF IBM DUAL ABLATION ROUTINE LVVZ12
J. K. Haviland and M. L. Mimier Apr. 5, 1963 82 p 4 refs
(Rept. 00.166)

The routine, written in FORTRAN, is capable of computing the ablation rate and internal temperature distribution of a one-dimensional two-component ablator, typified by a carbonized plastic or "burnt toast" system with an ablative filler. It also provides a reasonable approximation to the behavior of a charring ablator. Provisions are made for a simple substructure. Author

N63-23368 Princeton U., N.J. Guggenheim Labs. for the Aerospace Propulsion Sciences
HEAT TRANSFER IN OSCILLATING FLOW [Progress Report] for the Period to June 30, 1963
Luigi Crocco July 15, 1963 166 p 12 refs
(Contract Nonr 1858(29))
(Aeron. Eng. Rept. 483-e)

Pressure oscillations imposed upon a compressible fluid flowing in a duct produce a substantial increase of heat transfer between the heated duct wall and the fluid. This report records an experimental investigation of the causes of this increase. Resonant conditions in a duct were used to achieve increased oscillating amplitudes. The local heat transfer increase was found to be highly dependent on the amplitude of the local velocity oscillations, and to depend also on the frequency of oscillations and the duct steady-state pressure and Mach number. The presence of flow reversal further increased the observed heat transfer. Author

N63-23383 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INCREASING THE RATE OF COMBUSTION BY INTRODUCING AN INERT ADMIXTURE
N. N. Bakhman May 27, 1963 7 p 1 ref Transl. into ENGLISH from Doklady Akad. Nauk SSSR (Moscow), v. 145, no. 6, 1962 p 1328–1330
(FTD-TT-63-460/1+2)

Methods are given and discussed for increasing the rate of combustion by introducing an inert admixture into a system in which the combustion proceeds in a kinetic mode of operation, but one in which the heat emission is concentrated in one narrow zone. C.L.W.

N63-23385 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CONCERNING THE STABILITY OF THE BURNING REGIME OF A POWDER IN A SEMICLOSED SPACE
Ya. B. Zel'dovich Aug. 27, 1963 24 p 4 refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. Fiz. (Moscow), no. 1, Jan.–Feb., 1963 p 67–76
(FTD-TT-63-572/1+2+4)

The stability of steady-state burning of a powder in a semiclosed space is examined theoretically by the method of small perturbations, taking into account the temperature distribution in the powder, the effect of this distribution on the burning velocity, and the relation between the burning velocity and the pressure. The burning is shown to be unstable at low pressure. A criterion depending on the free volume of the chamber and on the area of the critical cross section of the nozzle is given for the conditions of stability. A pattern for the process during unstable burning is developed. P.V.E.

N63-23391 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STATIONARY THERMAL STRESS IN THIN CYLINDRICAL WALLS
C. Hoeschl Sept. 16, 1963 15 p 14 refs Transl. into ENGLISH from Strojirenstvi (Prague), v. 13, no. 4, 1963 p 243–247
(FTD-TT-63-726/1+2)

Simple, approximate formulas are presented for the calculation of thermal stresses in rotational, symmetrical, cylindrical shells for various boundary conditions at stationary fields of temperatures. The calculation process is based on samples of a free cylindrical wall, fixed at the ends. Symmetrical distribution of the thermal field is also assumed. Author

N63-23422 Chicago U., Ill. Inst. for the Study of Metals
HEAT CAPACITY OF α-$HiSO_4 \cdot 6H_2O$ BETWEEN 1 AND 20°K. ELECTRONIC ENERGY LEVELS OF THE Ni^{++} ION
J. W. Stout and Wayne B. Hadley [1963] 45 p 21 refs
(Contract Nonr-2121(13))

The heat capacity passes through a rounded maximum of 1.51 cal deg^{-1} $mole^{-1}$ at 2.58° K. From the heat capacity data, the energy spacing between the lowest and middle spin states is calculated to be 4.48 ± 0.07 cm^{-1}, and between the lowest and highest spin states 5.05 ± 0.07 cm^{-1}. The magnetic susceptibilities in the directions of the three principal axes of a Ni^{++} ion are calculated, and by comparison with literature data on the magnetic anistropy and single crystal magnetic susceptibilities, the orientations of these axes relative to the crystal axes are deduced. Author

N63-23484 Oklahoma U., Norman
RADIANT HEAT TRANSFER IN ABSORBING, EMITTING, AND SCATTERING MEDIA
T. J. Love *In* Aerospace Res. Labs. Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 380–387 (See N63-23471 24-24)

An analysis is made of radiant heat transfer between surfaces and media which absorb, emit, and scatter radiant energy with emphasis on the effect of scattering. A solution is presented for the problem of two infinite parallel walls separated by an isothermal medium. For the purposes of computation, the scattering medium is assumed to be composed of uniform spherical particles of known diameter and refractive index. This assumption provides for an analytical determination of the absorption and extinction coefficients, as well as the angular determination of the intensity of the scattered radiation. The approach to the problem was to solve the integro-differential equation by transfer by an approximate method, together with the integral equations which make up the boundary conditions resulting from partially reflecting boundaries. The analysis begins with the equation of transfer as presented by Chandrasekhar in his "radiative transfer." I.v.L.

N63-23485 Aerospace Research Labs. Wright-Patterson AFB, Ohio Thermo-Mechanics Res. Lab.
RADIATION FROM AN ALTERNATING CURRENT ARC

Paul W. Schreiber *In its* Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 388–445 refs (See N63-23471 24-24)

An experimental program is outlined which is concerned with the determination of the power radiated from a vortex-stabilized arc column as a function of arc and flow field parameters. This program includes measurements of the time-average total power radiated, and time-varying power radiated over the cyclic periods of the ac arc column. The instrumentation, calibration techniques, and their limitations, are discussed. A few typical radiation measurements are presented. Author

N63-23501 IIT Research Inst., Chicago, Ill.
STABLE WHITE COATINGS Summary Report, Sept. 21, 1961–July 15, 1963
Gene A. Zerlaut and Y. Harada Aug. 27, 1963 194 p 31 refs
(NASA Contract NAS7-100; JPL Contract 950111)
(NASA CR-52134; IITRI-C207-25) OTS: $13.50 ph, $6.02 mf

Investigations were conducted to develop a white thermal-control coating for spacecraft. The primary requirements were that the paint possess good stability to ultraviolet irradiation in vacuum, that the maximum allowable change in the ratio of solar absorptance to emittance be only 10% after one year of extraterrestrial solar radiation, that the ratio of solar absorptance to emittance be 0.20 ±0.05, and that the emittance be approximately 0.90. The other requirements were that the coating cure at less than 300° F and that it adhere to materials such as aluminum and conversion-coated magnesium through temperature changes of 50° F per minute between 200 and −100° F. It was found that satisfactory passive thermal control can be achieved with coatings of methyl silicone-bonded or potassium silicate-bonded zinc oxide. The paint must be stringently clean in order to prevent photolysis of contaminants, such as sebum and organic solvent residues. Author

N63-23510 Polytechnic Inst. of Brooklyn, N.Y.
VORTICITY EFFECT ON HEAT TRANSFER TO THE CONICAL PORTION OF A BLUNT BODY
Lu Ting Sept. 1963 28 p 14 refs
(Grant AF-AFOSR-1-63)
(PIBAL-797)

For a blunt body in high-speed flight, there exists, along the conical surface of the body, a vortical layer induced by the curved shock. This paper studies the effect of the vortical layer on the boundary layer by a systematic mathematical procedure of power series expansion and matching. Numerical results on velocity and enthalpy profiles are presented. The effects of vorticity on heat transfer and friction coefficients are obtained as functions of the outer stream Mach number, and the ratio of outer stream enthalpy to wall enthalpy. Author

N63-23520 European Atomic Energy Community, Brussels (Belgium)
DEVELOPMENT OF METHODS FOR THE DETERMINATION OF THE HIGH TEMPERATURE THERMAL DIFFUSIVITY OF UC
C. Mustacchi and S. Giuliani 1963 29 p refs Joint Nuclear Res. Center, Ispra Establishment (Italy), Chemistry Service (EUR 227.e) Available from Belgian American Bank and Trust Co., N.Y., account no. 121.86; 60 BF

A simple, modulated electron gun is used to determine the thermal diffusivity of uranium carbide in the range 1000° to 2000° C. Both sine wave and pulse techniques are applied to thin wafer-shaped samples of carbide. Temperature of the hind face is detected by means of a photocell–oscilloscope arrangement. Arc-cast carbide yielded a value .049± .004 cm^2 sec^{-1} for thermal diffusivity in the range in question. Values for emissivity, and for electrical and thermal conductivity were measured or derived for uranium carbide. Author

N63-23597 Thompson Ramo Wooldridge Inc., Cleveland, Ohio TAPCO Div.
HIGH TEMPERATURE SOLAR THERMIONIC GENERATORS First Quarterly Technical Progress Report, 15 Apr. 1963–31 July 1963
Aug. 15, 1963 49 p 3 refs
(Contract AF 33(657)-11169)

The two major goals of the program are: (1) to demonstrate that cesium-vapor thermionic converters operating at temperatures above 1600° C can have a satisfactory life of at least one year at efficiencies greater than 15%, and at power densities greater than 12 w/cm^2; and (2) to demonstrate that such high-temperature converters can be incorporated into a cavity generator capable of sustained operation at the focal point of a solar concentrator. Toward these goals, a cavity-type generator has been extensively tested under a solar flux range of 80 to 100 w/ft^2, and good correlation of the generator solar performance with previous laboratory performance has been obtained. Author

N63-23615 Lockheed Missiles and Space Co., Sunnyvale, Calif.
EXPERIMENTAL MEASUREMENTS OF VELOCITY AND TEMPERATURE PROFILES AND SKIN-FRICTION IN SUPERSONIC TURBULENT COMPRESSIBLE FLOW; AN ANNOTATED BIBLIOGRAPHY
Eugene E. Graziano, comp. June 1963 32 p refs
(Rept. 6-90-63-57; SRB-63-1)

The period searched was Jan. 1950 to April 1963. Many of the documents cited contain theoretical treatments of the problem, and include related materials. Included were cases with and without longitudinal pressure gradients, and with and without heat transfer. Any body shape and any compressible fluid were acceptable. Author

N63-23634 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DETERMINATION OF THE HEAT-TRANSFER COEFFICIENTS IN SUPERSONIC TUBE FLOWS OF A RAREFIED GAS
A. Ye. Marenov Sept. 7, 1962 15 p 8 refs Transl. into ENGLISH from Inzhenernyy Sbornik (Moscow), v. 30, 1960 p 139-148
(FTD-TT-62-974/1+2+4)

The local heat-transfer coefficients in a flow of rarefied gas with supersonic velocity, along cylindrical tubes of constant cross sections, were determined. A formula for calculating the heat-transfer coefficients within the investigated parameter was recommended on the basis of the experimental data. R.T.K.

N63-23638 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
ON THE SOLENESS OF SOLUTION OF BASIC PROBLEM CONCERNING FREE THERMAL CONVECTION OF LIQUID
I. G. Sevruk Jan. 18, 1963 8 p refs Transl. into ENGLISH from Izvest. Vyssh. Ucheb. Zaved., Mat. (Kazan), no. 4, 1958 p 218–221
(FTD-TT-62-1613/1)

The uniqueness of the solution for the following problem is shown. Assuming that in a certain volume V, limited by a closed surface S, there is situated in a state of thermal convective movement a viscous, mechanically incompressible liquid, and assuming that on the boundary of the zone and at the

initial moment of time there is given the distribution of velocity and temperature of the liquid. It is then necessary to find the distribution of these values by the volume of the liquid at a given moment of time. P.V.E.

N63-23714 Bureau of Mines, Tuscaloosa, Ala. Tuscaloosa Metallurgy Research Center
THERMODYNAMIC PROPERTIES OF STRONTIUM CHLORIDE AND STRONTIUM FLUORIDE FROM 0° to 300° K
D. F. Smith, T. E. Gardner, B. B. Letson, and A. R. Taylor, Jr. 1963 12 p 6 refs
(BM-RI-6316)

Low-temperature heat capacities of strontium chloride (7° to 300° K) and strontium fluoride (11° to 300° K) were measured with an adiabatic calorimeter. Smooth values of heat capacity, entropy, enthalpy function, and free-energy function were calculated from the heat-capacity data. The smooth values are reported at 10° K intervals and at 273.15° and 298.15° K. Author

N63-23715 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
THERMODYNAMIC PROPERTIES TO 6000° K FOR 210 SUBSTANCES INVOLVING THE FIRST 18 ELEMENTS
Bonnie J. Mc Bride, Sheldon Heimel, Janet G. Ehlers, and Sanford Gordon Washington, NASA, 1963 332 p refs
(NASA SP-3001) OTS: $5.00

Consistent tables of thermodynamic properties at temperatures from 0° to 6000° K were compiled for 210 gaseous and condensed species involving the elements with atomic numbers of 1 to 18. The tables give the following thermodynamic functions for the standard state: heat capacity at constant pressure, sensible enthalpy, entropy, sensible free energy, and the sum of sensible enthalpy and chemical energy at 0° K, as well as values of the enthalpy changes and the logarithms of the equilibrium constants. Author

N63-23719 Coating and Chemical Lab., Aberdeen Proving Ground, Md.
DEVELOPMENT AND EVALUATION OF A LABORATORY BENCH SCALE HEAT TRANSFER APPARATUS
Robert R. Buntin Aug. 30, 1963 26 p refs
(CCL-146) OTS: $0.75

A bench unit was constructed and used for measuring forced-convection heat-transfer coefficients of several typical coolants. Measurements were made under boiling and nonboiling conditions. The method employed uses a small electrically heated wire as a heat dissipating surface, and at the same time, as a resistance thermometer for determining surface temperature. The usefulness of the unit has been demonstrated by preliminary data showing significant differences in heat-transfer ability of presently used coolants, especially at higher metal temperatures. The unit is also capable of providing data on the effect of corrosion or other surface reaction on heat transfer. Author

N63-23775 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
STUDIES OF THE THERMAL DEGRADATION OF TEFLON
Leo Reich, H. T. Lee, and David W. Levi Sept. 1963 34 p 18 refs
(Tech. Rept. 3095)

Teflon 7 was thermally degraded in vacuum both at constant temperature and at a constant heating rate. Activation energies are reported. The reaction was found to be first-order throughout the temperature range investigated. Two new procedures for rapid treatment of kinetic data are reported, and the results are compared with conventional procedures. Author

N63-23801 Chance Vought Corp., Dallas, Tex. Astronautics Div.
A STUDY OF HEAT SHIELD MATERIAL SYSTEMS FOR LUNAR RE-ENTRY
J. E. Medford and B. P. Rolfe [1963] 118 p refs
(Rept. 00.183)

The purpose of this program was to determine what material systems are competitive for thermal protection of advanced lunar reentry vehicles. Systems incorporating radiation cooling, ablative cooling, and passive insulation have been considered. These systems and their thermal properties are discussed and described. The specific environment used is presented. The thermal computer programs and radiant heating experiments used are discussed. Optimum material systems are determined as a function of total heat load. Author

N63-23818 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STUDIES ON ABLATION OF OBJECTS TRAVERSING AN ATMOSPHERE
Ernst W. Adams, John D. Warmbrod, and Benton K. Berry June 19, 1963 42 p refs
(NASA TM X-50999; MTP-AERO-63-47) OTS: $4.60 ph, $1.46 mf

This report reviews theoretical studies performed with regard to the ablation-type heat protection of vehicles traversing an atmosphere. These studies rest on numerical solution methods of the pertinent, partial differential equations representing balances of mass, momentum, and heat. Provided sufficiently small steps are used, the numerical calculation methods yield exact solutions for homogeneous and noncharring materials. Author

14 HUMAN BEHAVIOR

Includes: crew training and evaluation; piloting; psychological factors.

For simulators see: 10 Facilities.
For related information see: 16 Life Sciences.

N63-23026 National Aeronautics and Space Administration. Launch Operations Center, Cape Canaveral, Fla.
LAUNCH OPERATIONS CENTER PROGRESS REPORT (SUPPORT OPERATIONS)
Mar. 27, 1963 46 p
(NASA TM-X-50889) OTS: $4.60 ph, $1.58 mf

The status of the following supporting activities at the Launch Operations Center, Cape Canaveral, is reported: (1) community development, including airport facilities, higher education, housing, community impact coordination, and traffic controls; (2) safety, including the use of a radioactive source, coordination of safety efforts, operational safety survey, and disabling-injury reports; (3) public relations; (4) financial management, including administration, internal review, and budget; (5) support services, including documentation and transportation; (6) security; (7) personnel, including education, employee development, awards, and recruiting; (8) technical information; and (9) liaison with Marshall Space Flight Center. M.P.G.

N63-23189 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AN-24: OPERATIONAL FEATURES

V. Glazkov Aug. 22, 1963 10 p Transl. into ENGLISH from Grazhdanskaya Aviatsiya, (USSR) no. 5, 1963 p 10–11 (FTD-TT-63-791/1+2)

Operational and technical flight characteristics are given for the An-24 turboprop, high-speed aircraft as designed for commercial flights. The An-24 will fly basically local routes, and is therefore compared with the Il-14 piston-type passenger aircraft. Technical and operational comparisons of the two aircraft indicate the superiority of the An-24 aircraft. R.T.K.

N63-23200 Advisory Group for Aeronautical Research and Development, Paris (France)
ANTHROPOMETRIC SURVEY OF TURKEY, GREECE AND ITALY
H. T. E. Hertzberg, Edmund Churchill, C. Wesley Dupertuis, Robert M. White, and Albert Damon Oxford, N.Y., Pergamon Press, 1963 309 p 137 refs
(AGARDograph 73) $15.00 or £5 5s

The results of a survey of 150 body dimensions of Turkish, Greek, and Italian military personnel are presented. The data obtained will provide a guide for the sizing and economical procurement of all types of military clothing and personal equipment and for the design of seats, cockpits, and other workplaces for these military populations. The trend of body dimensions among these populations ranged from smallest among Turks, to intermediate among Greeks, to largest among Italians. Where available, U.S. Air Force data are included for comparison. Detailed verbal and visual instructions are included to assist in standardizing anthropometric techniques, and additional measurements were included to increase the usefulness of these data in other biological disciplines. M.P.G.

N63-23215 Minneapolis-Honeywell Regulator Co., Minn.
EFFECT OF MATERIALS ON ATMOSPHERIC CONTAMINATION IN MANNED SPACECRAFT
Luther L. Bolstad *In* AIAA 2nd Manned Space Flight Meeting [1963] p 99–110 refs (See N63-23201 24-01)
(Supported by North Amer. Aviation, Inc.: Proj. Apollo)

This paper describes an experimental program which will determine the relative outgassing and flammability characteristics of over 100 materials, including surface coatings, wire insulations, tying cords, molding compounds, adhesives and casting compounds. Experimental apparatus and analytical techniques are described. Preliminary results obtained from the experimental testing programs are presented with special emphasis on flammability characteristics of materials in pure oxygen. Author

N63-23217 Naval Medical Research Inst., Bethesda, Md.
SELECTION AND EFFECTIVENESS CONSIDERATIONS ARISING FROM ENFORCED CONFINEMENT OF SMALL GROUPS
John E. Rasmussen and William W. Haythorn *In* AIAA 2nd Manned Space Flight Meeting [1963] p 114–119 refs (See N63-23201 24-01)

The closed ecological systems of manned space vehicles and future weapon systems will engender specific individual and interpersonal stresses, the overall significance of which will exceed anything heretofore encountered. Mission success is dependent upon more than adequate human engineering and the selection of technically qualified and trained personnel. Two additional variables are introduced by the use of small crews in the closed ecology of space and future weapon systems vehicles. Effectiveness of interpersonal interaction among personnel operating the system is a critical variable in mission success. Secondly, factors inherent in prolonged isolation and physical confinement assume a significant magnitude in both individual and group effectiveness. The nature, significance, and implications of these problems are discussed in terms of crew compositions, maintenance of crew effectiveness, closed space environment problems, and performance criteria. I.v.L.

N63-23226 National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.
FLIGHT SAFETY ASPECTS OF MANNED SPACE FLIGHT
Frederick J. Bailey, Jr. *In* AIAA 2nd Manned Space Flight Meeting [1963] p 195–198 (See N63-23201 24-01)

Operational procedures which have proven valuable in efforts to augment flight safety are discussed. These procedures are: development engineering inspection, factory rollout inspections, interface controls, flight safety reviews, and environmental and operational mission simulations. Also, design areas where special measures seem indicated to reduce hazards peculiar to space operations are discussed. These areas are: zero-g environment, structural deformation, heat removal and equipment temperature control, and fuel management. I.v.L.

N63-23251 Douglas Aircraft Co., Inc., Long Beach, Calif.
COMPLEX VEHICULAR CONTROLS
Alan A. Burrows and Jerry A. Emery, eds. [1962] 300 p refs Proc. of Symp. held at the RAF Inst. of Aviation Med., Farnborough, May 1962
(Sponsored by ONR)

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13. A THEORY OF HANDLING QUALITIES DERIVED FROM PILOT-VEHICLE SYSTEM CONSIDERATIONS Irving L. Ashkenas and Duane T. Mc Ruer (Systems Technol., Inc.) p 188–242 refs (See N63-23264 24-14)

14. STUDIES OF MANUAL ATTITUDE CONTROL: INERTIAL CROSS-COUPLING EFFECTS D. K. Bauerschmidt, R. O. Besco, and Carolyn S. Mc Elwain (Hughes Aircraft Co.) p 243–260 refs (See N63-23265 24-14)

15. TANDEM PROPELLER SUBMARINE CONTROL SYSTEM F. R. Haselton, Jr., and Robert C. Mc Lane (Office of Naval Res.) p 261–284 refs (See N63-23266 24-14)

N63-23252 Naval Research Lab., Washington, D.C.
HUMAN EQUALIZATION: CONCEPT, MACHINE AND MEASUREMENT
Rube Chernikoff *In* Douglas Aircraft Co., Inc. Complex Vehicular Controls [1962] p 1–20 refs (See N63-23251 24-14)

The complexity of response movement in the higher-order controlling of airplanes, helicopters, or submarines and the imprecision of man's performance in processing functions, such as differentiation, analog addition, multiplication by constants, and integration illustrates the nature and difficulty of human equalization tasks (compensation for control system dynamics). A device is described for developing operator skill in equalizing and for measuring the level of this skill possessed by an individual. The prime feature of the device is its ability to provide an equalization task which accurately matches the operator's ability to equalize through reduction in quickening. This is accomplished by means of a servosystem which operates from a modification of his error. The score for any one tracking trial is the amount of quickening furnished by the machine for that trial. The two-coordinate, third-order tracking task involved is sufficiently difficult to require considerable learning so that a slope can be obtained representing the rate at which each subject learns to equalize. I.v.L.

N63-23253 Boulton Paul Aircraft, Ltd., Wolverhampton (Gt. Brit.)
MANUAL CONTROL AS A STOCHASTIC PROCESS
John D. North *In* Douglas Aircraft Co., Inc. Complex Vehicular Controls [1962] p 21–37 refs (See N63-23251 24-14)

The sequence of observed deviations in an experimental run is, in the case of a compensatory task, the sum of the expected value of the deviation which depends on the input (target), the tactic used by the operator, and the character of the mechanical extension. The expected value cannot be observed but it is possible to choose an input such that in the steady state the expected value is everywhere zero. With a rate control, this condition is satisfied by a constant velocity input; the observed deviations may be examined on the hypothesis that they are a sample sequence of the autoregressive process of the third order satisfying the stochastic equation: $X_{t+3} + (C/2 - 2)X_{t+2} + (B+1)X_{t+1} - C/2X_t = \epsilon_t$. B is the nondimensional weight attached to deviation and C is the nondimensional weight attached to the rate of change of deviation. It is assumed that the discrete interval is equal to the delay time which is then adopted as the unit of time. The statistical consequence is that $\hat{B}$ and $\hat{C}$, the estimators of B and C, can be derived from the first three Walker–Yule equations. Also, the properties of residuals are discussed. I.v.L.

N63-23254 Medical Research Council, Cambridge (Gt. Brit.) Applied Psychology Res. Unit
THE HUMAN OPERATOR AS AN INTEGRATOR
E. C. Poulton *In* Douglas Aircraft Co., Inc. Complex Vehicular Controls [1962] p 38–45 refs (See N63-23251 24-14)

An amplifying (positional) control system with direct control-display linkage is discussed. This system overcomes the disadvantages of a rapid succession of compatible and incompatible control-display relationships which result from man's moving his control in the same direction as the movement of the input in two quarters of each input cycle, whereas in the other two quarters of the input cycle, he moves his control in a direction reverse to the movement of the input. The amplifying control system works well with both HF and LF inputs. I.v.L.

N63-23255 Dunlap and Associates, Inc., Stanford, Conn.
SOME SYSTEM CONSIDERATIONS AFFECTING THE DESIGN OF CONTROLS
Charles R. Kelley *In* Douglas Aircraft Co., Inc. Complex Vehicular Controls [1962] p 46–72 (See N63-23251 24-14)

Factors influencing the design of human "control systems" are: (1) the transmission of information forward from man to the control; (2) the quantity of information transmitted; and (3) the transmission of information back from the control to man. Also, a proposed attitude rate command system is discussed. In this system, a control for an on–off valve would be designed in such a way that the control would open the valve for a length of time proportional to the displacement of the control; the displacement would order, not a varying force, but a varying time of application of constant force. I.v.L.

N63-23256 Medical Research Council, Cambridge (Gt. Brit.)
THE ROLE OF STRUCTURE IN SERIAL CHOICE TASKS
J. A. Leonard *In* Douglas Aircraft Co., Inc. Complex Vehicular Controls [1962] p 73–86 (See N63-23251 24-14)

The role of structure in serial choice tasks is reviewed. In one experiment cited, an attempt was made to teach naval subjects to learn a twenty-item vocabulary: when Ss held down a morse key a train of pulses running at about 7 1/2 per second was activated; what Ss had to learn was to hold down the key for anything between 1 and 20 pulses, according to the instructions given by the experimenter. Moment-to-moment feedback from the pulse train was studied. Therefore, in one condition S just heard single-pitch pips for as long as he held the key down; in the second condition every fifth click was of a higher order pitch; and in the third condition there was an arpeggio of five ascending notes which restarted every fifth pip. The fifth marker and the arpeggio clearly put some sort of structure into the task. Putting in the structure helped many subjects in performing the task. However, there were subjects who did extremely well in the unstructured condition. Also presented are results of tests where the structure was "messed about with". I.v.L.

N63-23257 Royal Air Force, Farnborough (Gt. Brit.) Inst. of Aviation Medicine
FACTORS AFFECTING VISION DURING VEHICULAR VIBRATION
D. H. Drazin *In* Douglas Aircraft Co., Inc. Complex Vehicular Controls [1962] p 87–105 refs (See N63-23251 24-14)

Pursuit eye movement rapidly degenerates when the frequency increases beyond 1 c/s. However, the limitations of pursuit eye movement can be overcome by collimation. Angular oscillation of the head presents a far less tractable problem. When the head is subject to passive rotational movement in a static environment, "compensatory" eye movements assist

in stabilizing the retinal image. But the output of this reflex mechanism falls off rapidly at frequencies exceeding 1 c/s. Thus, nodding movements of the head excited by vibration of the crew compartment in a translational mode at frequencies above 2 c/s will result in a blurred retinal image. A similar situation arises if the vehicle itself is subjected to angular oscillation. Also, the design and arrangement of dials and other forms of display, to facilitate interpretation under conditions of retinal blurring, are discussed. I.v.L.

N63-23258 SAAB Aircraft Co., Linkoping (Sweden)
EFFECT OF BANKING OF THE FIELD OF VISION ON MANUAL TRACKING PERFORMANCE
Lennart Nordstrom *In* Douglas Aircraft Co., Inc. Complex Vehicular Controls [1962] p 106–122 (See N63-23251 24-14)

Significant effects of banking of the field of vision on manual tracking has been obtained. Fixed banking angles and sinusoidal programs with banking angles up to 60° have been studied. The banking effects were smaller in a system with the control stick signal resolved than in a system without a resolver. The main part of the investigation was performed with a system without a resolver and the movements of the controlled element orientated to a reference system banking relative to the operator. The banking influence was much greater for a second-order system than for a system of the first order and also greater for greater input amplitudes. The influence of the rate of change of the banking angle for a sinusoidal banking program with an amplitude of 60° was not significant when the period time was between 40 and 20 seconds. When this was reduced to 10 seconds, the banking effect was increased and the steering errors significantly greater. These results can probably be applied to a manually guided air-to-ground missile system. I.v.L.

N63-23259 Autonetics, Anaheim, Calif.
COMPENSATORY TRACKING PERFORMANCE AS A FUNCTION OF FILTER TIME CONSTANT AND CONTROL GAIN
Herschel C. Self and James S. Sweeney *In* Douglas Aircraft Co., Inc. Complex Vehicular Controls [1962] p 123–139 refs (See N63-23251 24-14)

An investigation was made of a man–machine tracking system in which the machine dynamics were supplied by three cascaded low-pass filters. Two control gain levels and eight filter time constants were utilized. The operators manipulated a joy-stick and observed a compensatory display of error on a CRT. At low control gain, integrated error increased with the time constant, but at high control gain a more complex relationship existed between filter time constant and tracking performance. Author

N63-23260 Medical Research Council, Cambridge (Gt. Brit.) Applied Psychology Res. Unit
A SOURCE OF NON-LINEARITY IN PURSUIT TRACKING
E. C. Poulton *In* Douglas Aircraft Co., Inc. Complex Vehicular Controls [1962] p 140–148 refs (See N63-23251 24-14)

A case is described in which a few simple measurements indicated a nonlinearity which would have been difficult to tie down precisely using the describing-function technique. In the experiment, the man does not simply reproduce the curve input with a variable error and a more-or-less constant time lag; he makes a series of aiming movements from one side to the other. Each aiming movement starts off at a greater rate than the corresponding part of the input, and slows down at the end more gradually than the input does. This shows up clearly if the time error at the reversals in the direction of movement, at the points of inflection on the input, and at points in time between them are measured. The time error is greatest at reversals, since the man's pen has been moving more slowly than the input has. The time error is least at the points of inflection, since the man's pen has just been moving more rapidly than the corresponding part of the input. I.v.L.

N63-23261 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
A NOTE ON DISPLAY AUGMENTATION VERSUS VEHICLE AUGMENTATION AS THEY APPLY TO THE IMPROVEMENT OF MAN-VEHICLE CONTROL PERFORMANCE
Leonard Segel *In* Douglas Aircraft Co., Inc. Complex Vehicular Controls [1963] p 149–172 refs (See N63-23251 24-14)

A definition of the human controller-vehicle system is presented that is sufficiently generalized to encompass both the process of vehicle augmentation and the process of display augmentation. The objective is to produce an integrated assessment of the manual-control task as seen from the perspective of results obtained in (1) aircraft handling-qualities research, (2) human-dynamics research, and (3) control-system investigations on a variety of other vehicles, including automobiles, submarines, and helicopters. Specific examples of vehicle and display augmentation are cited and criteria for choosing one or the other (or a combination of both) in a control-system synthesis task are discussed. Some previously unpublished experimental data, which are applicable to the topic under discussion, are presented. I.v.L.

N63-23262 Systems Technology, Inc., Inglewood, Calif.
THE MAN MACHINE SYSTEM CONCEPT AND AIRCRAFT HANDLING QUALITIES
D. T. Mc Ruer and E. S. Krendel *In* Douglas Aircraft Co., Inc. Complex Vehicular Controls [1963] p 173–174 (See N63-23251 24-14)

The vehicle-handling quality subdivisions include the evolution of theory as a first step. Using the theory evolved, pilot models and vehicle characteristics are combined analytically to derive significant parameters of the aircraft. The significant parameters derived are then validated experimentally. Then is considerable feedback in this process, and from experimental to theoretical results. After a fixed-base simulation and validation, a further validation is often performed using an actual flight situation. Under the human pilot characteristics (the human response part of this program), two aspects are presented: first, experimental and secondly, interpretative. Analytical models of pilot behavior are developed which serve as convenient capsules of the actual experimental data. I.v.L.

N63-23263 Systems Technology, Inc., Inglewood, Calif.
THE MAN-MACHINE SYSTEM CONCEPT
D. T. Mc.Ruer and E. S. Krendel *In* Douglas Aircraft Co., Inc. Complex Vehicular Controls [1963] p 175–187 refs Repr from Proc. IRE, v. 50, no. 5, May 1962 (See N63-23251 24-14)

The man–machine concept, as treated in this paper, refers to a system comprising a machine and an actively participating individual man. Central to the man–machine concept in this context is the specification of human skills under circumstances where man's mechanical outputs serve as machine inputs, and machine outputs are among the inputs to the man. Emphasis is placed on (a) possible man–machine effective system structures and (b) human response measurements for compensatory systems. I.v.L.

N63-23264 Systems Technology, Inc., Inglewood, Calif.
A THEORY OF HANDLING QUALITIES DERIVED FROM PILOT-VEHICLE SYSTEM CONSIDERATIONS

Irving L. Ashkenas and Duane T. Mc Ruer *In* Douglas Aircraft Co., Inc. Complex Vehicular Controls [1963] p 188–242 refs Repr. from Aerospace Eng., no. 21, 1962 p 60–102 (See N63-23251 24-14)

The pilot-aircraft system theory of handling qualities starts with the dynamics of the system elements. These component dynamic characteristics are then combined analytically to find closed-loop system and pilot-adapted dynamic characteristics. On the premise, partially supported by experiment, that these latter are primary bases for pilot assessment, the closed-loop analyses can be used to select those aircraft parameters important to handling qualities assessments. Finally, these parameters so uncovered can be subjected to detailed examination in handling-qualities experiments to determine more precisely their connection with pilot ratings. All of these aspects of the theory and many of its principal consequences are discussed. I.v.L.

N63-23265 Hughes Aircraft Co., Culver City, Calif.
STUDIES OF MANUAL ATTITUDE CONTROL: INERTIAL CROSS-COUPLING EFFECTS
D. K. Bauerschmidt, R. O. Besco, and Carolyn S. Mc Elwain *In* Douglas Aircraft Co., Inc. Complex Vehicular Controls [1963] p 243–260 refs (See N63-23251 42-14)

The inertial cross-coupling effects of five vehicle shapes (symmetrical, short cylinder, long cylinder, lenticular, and asymmetrical) on manual attitude performance were investigated. Results indicate that: (1) Cross-coupling causes an appreciable decrement in stabilization performance. (2) The spherical vehicle, with no cross-coupling, required less fuel than any other shape. (3) The presentation of roll, pitch, and yaw body-rates resulted in reduced fuel consumption for every vehicle shape. (4) Astronaut stabilization performance with well-designed manual systems should compare favorably with the performance ofpractically attainable automatic systems. Also, experimentally obtained integrals of commanded acceleration about the roll, pitch, and yaw axes for each vehicle shape and display condition are presented. I.v.L.

N63-23266 Office of Naval Research, Washington, D.C.
TANDEM PROPELLER SUBMARINE CONTROL SYSTEM
F. R. Haselton, Jr., and Robert C. Mc Lane *In* Douglas Aircraft Co., Inc. Complex Vehicular Controls [1963] p 261–284 refs (See N63-23251 24-14)

A control-display configuration was developed to investigate the problem of how a human operator can monitor attitude and motion information of a multi-degree-of-freedom underwater vehicle and effectively use this information to control the system. All available control input axes are described, as well as the associations with vehicle axes currently being used. Steps were taken in both designing the control input devices as well as in conditioning the signals taken from them in order to eliminate or minimize physical coupling of controls. Results indicate that the tandem propeller submarine concept appears to offer a vehicle which can be controlled in a satisfactory manner by one human operator, given the appropriate control input devices, and a contact analog type display. Experiments were conducted with a sufficient number of subjects to establish the fact that one human operator can control a four-degree-of-freedom vehicle with the expected dominant dynamic response characteristics of a tandem propeller submarine. I.v.L.

N63-23338 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.
PSYCHIATRIC ASPECTS OF THE SAM TWO-MAN SPACE CABIN SIMULATOR
Earl H. Cramer Sept. 1963 19 p 14 refs
(SAM-TDR-63-27)

Crew interaction was observed periodically over closed-circuit television and surveillance microphones. Other information was obtained from diaries and debriefings. Many situations and factors, which have been forecast in the literature as having potential psychiatric significance, did not appear to be problems on these simulated flights. Some factors, however, such as work-rest schedules, boredom, and interpersonal relations, do appear as areas of potential concern on actual prolonged space flight. Author

N63-23658 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.
SPATIAL DISORIENTATION – CURRENT CONCEPTS AND AEROMEDICAL IMPLICATIONS
Robert H. Bonner Aug. 1963 28 p 56 refs
(*Its* Aeromedical Review 7-63)

Spatial disorientation is defined as a state of confusion concerning the subject's true position in space, and its role in the piloting of aircraft is discussed. The discussion includes unperceived motion, sensation of climbing in a turn, sensation of diving when recovering from a turn, estimating the degree of a bank, unperceived banks, opposite tilt in a skid, illusion of turning, coriolis, leans, the oculogyral illusion, the oculogravic illusion, the autokinetic illusion, the elevator illusion, body-position disorientation, and miscellaneous illusions. C.L.W.

N63-23810 Aerospace Medical Div. Wright-Patterson AFB, Ohio Aerospace Medical Research Labs., (6570th)
PERFORMANCE TESTING: TESTING FOR WHAT IS REAL
John P. Foley, Jr. June 1963 21 p refs
(AMRL Memo. P-42)

This memorandum presents the difficulties involved in developing and administering performance examinations, the dangers of depending on written examinations as substitutes for performance examinations, and the fact that there is a lack of research information on the valid substitution of written for performance examinations. It proposes developmental research with a view to simplifying performance examination procedures and establishing valid guide lines as to the scope of written examinations in measuring job behaviors. It, also, makes some recommendations concerning immediate action that can be taken to improve the validity of current technical training examination procedures. Author

15 INSTRUMENTATION

Includes: design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; and sensors and transducers.

***For related information see:* 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.**

N63-23031 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A DUAL RATE GYRO APPROACH TO THE ELASTIC FEEDBACK PROBLEM
Robert C. Lewis and Thomas E. Carter Mar. 4, 1963 57 p 4 refs
(NASA TM X-50814; MTP-AERO-63-21) OTS: $5.60 ph, $1.91 mf

This dual rate-gyro concept is different from conventional stabilization methods in the following way: by subtracting

the outputs of two rate gyros at different locations on the vehicle axis, the rigid body mode is eliminated from the total rate gyro signal. This resultant signal, which still contains bending information, passes into the special bending filter where it is divided into separate bending-mode components. These separate bending-mode components are then weighted and fed into the control loop to phase or gain stabilize the elastic vibrations. The purpose of this report is to present this dual rate-gyro stabilization concept and to demonstrate its application using a simplified booster model. Author

N63-23049 European Organization for Nuclear Research, Geneva (Switzerland)
A TELESCOPE TO IDENTIFY ELECTRONS IN THE PRESENCE OF PION BACKGROUND
T. Massam, Th. Muller and A. Zichichi June 27, 1963 14 p 3 refs
(CERN-63-25)

A telescope is described which can be used to distinguish electrons and pions of the same momenta in the Gev region with an error probability of 0.3%. It consists of a 1-cm slice of lead, followed by a 28-cm diameter, 1-cm thick scintillation counter, and, finally, by a 35-cm diameter, 30-cm long lead-glass Cerenkov counter. The lead sheet and scintillation counter serve to make a preliminary rejection of the pions because high-energy electrons will start a cascade shower in the lead sheet. The resulting electron pulse height in the scintillation counter will therefore have a much higher peak than the pulse-height distribution of a pion of the same momentum. The further development of the cascade showers occurs in the lead-glass Cerenkov counter. In an experimental trial of this telescope, electrons of momenta in the range 1 to 2.5 Gev/c were detected with an average efficiency of ~80%, whereas the corresponding pion contamination was only 0.3%. M.P.G.

N63-23054 Tokyo U. (Japan) Aeronautical Research Inst.
THERMOANALYTICAL STUDIES ON THERMAL STABILITY OF HIGH POLYMERS. I. AN AUTOMATIC RECORDING THERMOBALANCE AND THERMOGRAVIMETRIC ANALYSIS OF POLYETHYLENE
Hirotaro Kambe and Shoichi Igarashi Aug. 1963 17 p 8 refs (*Its* Rept. 376 (Vol. 28, No. 8))

A deflection-type automatic recording thermobalance using a metal spring and a differential transformer is described. Using this apparatus, thermogravimetric analysis of a high-density polyethylene is carried out in the presence of air and in nitrogen atmosphere at a constant heating rate of about 1° C/min. In the presence of air, the oxidative degradation takes place in two stages; the first stage occurs over the temperature range from ca. 340° to 370° C, and the second stage from ca. 370° to 450° C. But in nitrogen atmosphere, thermal degradation of polyethylene occurred in one stage over the range from ca. 350° to 450° C. Author

N63-23068 Baldwin-Lima-Hamilton Corp., Philadelphia, Pa.
A GAGE FOR STRAIN MEASUREMENT AT HIGH TEMPERATURE
James Dorsey Oct. 12, 1962 Presented at the Western Regional Strain Gage Committee

A new type of strain gage, a full-bridge weldable strain gage, is described. This gage configuration includes four strain gages, two longitudinal gages mounted close to the center line of the weldable shim, and two transverse gages mounted outboard of the longitudinal units. The sensor is installed by welding the structure along the center line. In this manner, only axial strain can be sensed. The longitudinal gages sense strain close to that strain introduced along the weld line, and the transverse gages sense practically no strain but provide very good dummy compensation. The design and construction of this gage greatly minimize the effects of temperature on apparent strain and change in bridge sensitivity. Its utilization decreases, quite significantly, the performance requirements of strain sensing alloys, of the insulating coatings on such alloys, and of the bonding cements required to intimately bond the sensors to the shim material. I.v.L

N63-23136 General Dynamics Corp., San Diego, Calif. General Atomic Div.
A THIN CALORIMETER FOR PULSED-RADIATION DOSIMETRY
V. A. J. van Lint Sept. 24, 1963 6 p Submitted for Publication (GA-4497)

The use of a thin calorimeter as a dosimeter for intense pulsed radiation sources, such as electron linear accelerators and pulsed nuclear reactors, is described. A typical calorimeter, consisting of a small copper block suspended by fine thermocouple wires in an evacuated chamber with water-cooled walls, is diagramed. The portion of the beam to be monitored passes through two 0.001-in.-thick Mylar windows and the copper block. For a pulse of radiation delivered in a time that is short compared with the thermal relaxation time of the calorimeter block, the voltage change on the thermocouple is proportional to the dose. Doses in excess of 10^3 rad can be measured with a single radiation pulse; at lower doses per pulse, the radiation source is operated at a steady pulse-repetition rate while the rate of rise of the thermocouple voltage is recorded. A more sensitive calorimeter can be constructed using a thermistor as both the absorber block and the temperature-sensing element. M.P.G.

N63-23196 Comitato Nazionale per l'Energia Nucleare, Frascati (Italy) Lab. Nazionali
PROPOSAL FOR A UNITY OF AUTOMATIC SELECTION AND REGISTRATION OF IMPULSES(o) [PROPOSTA PER UNA UNITA' DI SELEZIONE E REGISTRAZIONE AUTOMATICA DI IMPULSI(o)]
M. Coli and A. Serra July 12, 1963 20 p In ITALIAN
(LNF-63/50; *its* Nota Interna 207)

A plan of the circuitry for automatic selection and recognition of impulses in a computer system is described. An application of the plan in the acquisition of data from a scintillation chamber is described. Trans. by P.F.E.

N63-23247 Paris U., Orsay (France)
THE SECONDARY EMISSION MONITOR
In its Invest. of Density Effect in Solids and Gases [1962] 34 p (See N63-23243 24-01)

This paper contains a short experimental study of the secondary emission properties of the secondary emission monitor. Also discussed is a theoretical search for the origins of the energy dependence of the secondary emission monitor which has been observed with relativistic electron beams. Author

N63-23345 Pacific Semiconductors, Inc., Lawndale, Calif.
PRODUCTION ENGINEERING MEASURE: RELIABILITY THRU PROCESS IMPROVEMENT Fourth Quarterly Report, Mar. 31–June 30, 1963
F. Chien, P. Kellow, D. Kliem, R. Lamoureux, and J. Logan et al [1963] 32 p
(Contract DA-36-039-SC-86742)
(PSI Rept. No. 3000-43-Q-4)

Equipment and process investigations in the areas of collector attachment, contact metalizing, lead attachment, and encapsulation have continued. The diffusion process is complete. Significant improvements have been achieved in gold-evaporated contacts. Author

N63-23386 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FLYWHEEL FOR GYROSCOPES
Theodor Duda Aug. 9, 1963 5 p Transl. into ENGLISH from Czech. Patent 93618, (Class 42c, 25/51) Jan. 15, 1960 p 1-3
(FTD-TT-63-602/1+2)

A flywheel consisting of an electrically driven, cylindrical mercury ring is described. The flywheel is formed by a permanent magnet, whose pole attachments form a closed annular space filled with mercury isolated from the walls of the space by a layer of enamel and insulation inserts. The insulation inserts carry conductive disks which connect the mercury ring to a source of dc current. P.V.E.

N63-23389 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
WONDER-CAMERA
M. Korolev Aug. 21, 1963 4 p Transl. into ENGLISH from Pravda (Moscow), no. 135, (16356), May 15, 1963 p 4
(FTD-TT-63-683/1)

An RKS-2 motion-picture camera capable of taking pictures with a frequency of 500 million frames per second is described. With the aid of this camera, pictures can be taken of discharges of pulsed-light sources, spark discharges, and other processes, which are compatible only with the speed of light. Small structural optical gratings are the most important part of the camera. These gratings consist of several thousand miniature lenses which arrange the image of the object into parts, with the smallest parts having a diameter of hundredths of a fraction of a millimeter. With the aid of rotating mirrors, the image is transmitted to the stationary photoplate. The rate of motion of the fastest image reaches 15000 m/sec, which is greater than the second cosmic velocity (escape velocity). I.v.L.

N63-23393 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATION OF THE SPECTROZONAL FILM SN-2 UNDER CONDITIONS OF PHOTOGRAPHY OF NATURAL OBJECTS
A. Ya. Smirnov Sept. 17, 1963 17 p 5 refs Transl. into ENGLISH from Zhur. Nauch. I Priklad. Fot. I Kinematografii (Moscow), v. 6, no. 3, May-June 1961 p 193-202
(FTD-TT-63-797/1+2)

A determination was made of the actinisms of the main species of forest growth on layers of the spectrozonal film SN-2 by three different experimental methods. On the basis of these determinations, accounts are given of the respective details of the actinisms. An analysis is made of the spectrozonal positive process. A method is given for determining, on the aerial positive, the characteristics of the elements of the photographed object according to the number of thresholds of color distinction. The balance is determined in accordance with the sensitivity of the film SN-2 for its use in aerial photography of forest growth. Author

N63-23404 Tufts U., Medford, Mass.
DIELECTRIC DISPERSION Annual Report, Oct. 1, 1962-Sept. 30, 1963
Karl H. Illinger [1963] 28 p refs
(Contract Nonr-494(19))

The design and construction of a broad-band microwave spectrometer operating continuously in the frequency region between 8.2 and 36 kmc are described. A detailed discussion is given of the design and performance characteristics of this instrument; measurement techniques for the determination of attenuation and reflection coefficients as a function of frequency are described. The spectrometer permits the study of pressure broadening of molecular transitions, occurring in the microwave region, as a continuous function of frequency and pressure. Measurements of self-broadening in NH_3 gas, obtained with this instrument, are discussed. Author

N63-23522 Thompson Ramo Wooldridge Inc., Cleveland, Ohio TAPCO Div.
FABRICATION OF A 60 INCH DIAMETER STRETCH FORMED ALUMINUM SOLAR CONCENTRATOR Final Report
C. H. Castle Sept. 14, 1962 54 p
(NASA CR-51542; ER-5048) OTS: $5.60 ph, $1.82 mf

Three 60-inch aluminum solar concentrators were fabricated for evaluation as to their possible use in space power-conversion systems. The concentrators were inspected and showed that the surface quality is not high enough for use in high-temperature conversion devices such as the thermionic type. It is, however, quite adequate for use in lower temperature conversion devices, such as the Rankine and thermoelectric types. The surface imperfections which prevent the concentrators from meeting the requirements for desired use in thermionic conversion devices were evaluated, and were found to be primarily due to a subgrade die resulting from an improper choice of die-fabrication methods. C.L.W.

N63-23612 Goodyear Aerospace Corp., Akron, Ohio
SOLAR ORIENTING DEVICE FOR EXPANDABLE FLAT-PANEL SOLAR ORIENTING DEVICE FOR EXPANDABLE FLAT-PANEL ARRAY Final Report, July 1, 1961-June 30, 1963
G. J. Mc Keel July 30, 1963 110 p refs
(Contract DA 36-039-SC-88913)
(Rept. No. 8; GER-11184)

Analysis of the apparent motion of the sun, wind effects, panel orientation, sun sensing, and basic system configurations are given. A section is presented on the operation, design, and fabrication of the single- and two-axis sun sensors. Experimental results on the single-axis sun sensor and its associated drive system are given. The experimental testing on the two-axis sun sensor and the complete two-axis system is included. Experimental results show the evolution from the simple automatic single-axis sensor with an accuracy of ± 10 degrees to the completely automatic two-axis system with pointing error of less than ± 1 degree Autl or

N63-23633 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THEORY OF PULSE COUNTERS AND ITS APPLICATION
Zdenek Koutsky Jan. 11, 1963 27 p 6 refs Transl. into ENGLISH from Aplikace Mat., v. 7, no. 2, 1962 p 116-140
(FTD-TT-62-1495/1+2)

A model is presented of a pulse counter with k positions (conditions). This pulse counter is nonsymmetrical, i.e., it can have various periods of relaxation in various positions, and in different positions for transition into next position, it must have different pulse levels. The pulse sources are described by Poisson's processes. Special attention is devoted to the study of boundary distribution of pulse number as well as the

results which may affect the formulation of the number of probabilities by physical means. The pulse sources are independent from each other and possess various pulse levels.
Author

N63-23637 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
DEVICE FOR MEASURING THE ABSOLUTE COEFFICIENTS OF MIRROR REFLECTION
O. A. Motovilov Dec. 12, 1962 4 p Transl. into ENGLISH from Russian Patent 141658 (689143/28), 1960 p 1-2
(FTD-TT-62-1510/1+2)

The known devices for measuring the absolute coefficients of mirror reflection, which contain optical attachments, produce large errors that are not adjustable by computation. One of the causes of these errors is the turning of the light beam after reflection from the measuring mirror. A device for measuring the absolute coefficients of mirror reflection was designed. For the purpose of increasing the precision of the measurement, the prism Dove-D, which turns the light beam, is set up before the mirror.
R.T.K.

N63-23667 Eppley Lab., Inc., Newport, R.I.
AN EXAMINATION OF THE CHARACTERISTICS OF PYRHELIOMETERS USED TO ESTABLISH STANDARD SCALES OF SOLAR RADIOMETRY AND THE DEVELOPMENT OF IMPROVED INSTRUMENTATION Final Report [Mar. 14, 1961-July 31, 1963]
A. J. Drummond Aug. 26, 1963 14 p
(Contract AF 19(604)-8339)
(AFCRL-63-887)

The main results of a trial field test program conducted at a high-altitude location are presented, and the conclusion drawn that to determine, precisely and accurately, differences in radiative flux density arising from varying the acceptance aperture of a solar pyrheliometer, a new design of instrument is called for. The development of such an improved pyrheliometer is described, as is the associated readout instrumentation.
Author

N63-23723 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
RESTORATION AND EXAMINATION OF THE L. A. SUKHAREV CO-ORDINATE MEASURING MACHINE
G. A. Plyugin Nov. 21, 1962 23 p refs Transl. into ENGLISH from Izv. Glavnoy Astron. Observ. v Pulkove (Leningrad), v. 22, no. 1, 1960 p 184-196
(FTD-TT-62-744/1+2+4)

This work gives a description of the coordinate measuring machine designed to measure 240- × 240-mm negatives. The basic operations in the restoration of the measuring machine, which was damaged during the war, are described. Studies of the progressive and periodic repairs to the screw and curvature of the guiding prism are cited. The machine is usable for exact astrographic measurements.
Author

N63-23766 Flying Personnel Research Committee (Gt. Brit.)
FURTHER DEVELOPMENT OF AN AIR VENTILATED LINING FOR A PARTIAL PRESSURE HELMET
J. M. Clifford, R. H. Farrow, and D. G. Robertson (R. A. F. Inst. Aviation Med.), [London] Air Ministry Dec. 1962 24 p 5 refs
(FPRC/Memo. 187)

The development and assessment of a new air-ventilated lining for use in conjunction with the Taylor Partial Pressure Helmet are described. The degree of reduction of airflow to this type of air-ventilated lining by the presence of a barometric shutoff valve in its air-supply line has been assessed.
Author

16 LIFE SCIENCES

Includes: biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness.

For related information see: 14 Human Behavior; and 28 Space Radiation.

N63-23005 Joint Publications Research Service, Washington, D.C.
RADIOACTIVITY IN DIAGNOSIS AND TREATMENT
A. V. Sevan'kayev et al Oct. 1, 1963 16 p 46 refs Transl. into ENGLISH of a review from Med. Rad. (Moscow), v. 8, no. 7, 1963 p 82-87
(JPRS-21280; OTS-63-31862) OTS: $1.50

A review of literature on the effect of ionizing radiation on the function of the vestibular analyzer is presented. As a result of the review, it is concluded that, after mass focal irradiation of the inner ear, an inflammatory reaction and degenerative changes of the nerve structures of the vestibular analyzer develop. After whole-body irradiation of the organism and focal radiation effects in relatively smaller doses, the changes which occur are often of a functional nature and amount basically to an increase in the excitability of the vestibular analyzer. At the present time, it is not possible to indicate the maximum dose of radiation which can cause only reversible changes in the activity of the vestibular analyzer or the dose which, with adequate compensatory mechanisms, will be the threshold for the function of the given analyzer.
P.V.E.

N63-23010 National Aeronautics and Space Administration, Washington, D.C.
EXCRETION OF 17-HYDROXYCORTICOSTEROIDS, CATECHOL AMINES, AND UROPEPSIN IN THE URINE OF NORMAL PERSONS AND DEAF SUBJECTS WITH BILATERAL VESTIBULAR DEFECTS FOLLOWING ACROBATIC FLIGHT STRESS Joint Research Report
James K. Colehour and Aston Graybiel Naval School of Aviation Med., May 10, 1963 14 p 27 refs
(NASA Order R-47)
(NASA CR-50501) OTS: $1.60 ph, $0.80 mf

Chemical measurements revealed that a significant increase in excretion of the stress hormones occurred in response to flight stress in case of the normal but not of L-D(labyrinthine defect) subjects which must have been attributable to the presence and absence, respectively, of the sensory organs of the inner ear. No significant changes in release of uropepsin were observed for either group. It is concluded that the vestibular organs must be taken into account in evaluating the effects of actual and simulated flight stresses where the gravitational inertial force environment is a variable.
Author

N63-23017 California U., Berkeley Lawrence Radiation Lab.
SUPPLEMENT TO BIOLOGY AND MEDICINE SEMIANNUAL REPORT, FALL 1962
Cornelius A. Tobias et al 1962 22 p
(NASA Order R-41; Contract W-7405-eng-48)
(NASA CR-51998; UCRL-10683, Suppl.) OTS: $2.60 ph, $0.86 mf

A discussion is presented which includes: progress on instrumentation for biological research with an 88-inch cyclotron; characteristics and intensity profile of a high-energy proton beam after scattering in a thick target; the pattern of depth dose in a spherical phantom, irradiated omnidirectionally with high-energy protons; the dose response of glass, thermoluminescent and film dosimeters to high-energy charged particles; difference in the acute radiation syndrome and its dose-rate dependence for 100 kvp X-rays; factors influencing RBE (radiation biological effect) of high-energy protons; the effects of cosmic radiation on seed differentiation and development; the modification of radiation injury with magnetic fields; the recovery of yeast following heavy-ion irradiation; the interpretation of the multihit curve in terms of the theory of compartments; diffusion–gravity controlled enzyme-substrate reaction; and convection in low gravitational fields. C.L.W.

N63-23047 North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

TELEMETERING SYSTEMS FOR THE LIFE SCIENCES A SURVEY

Mar. 15, 1963 94 p 508 refs

(SID-63-284)

This report surveys the international literature in the last 10 years on methods for telemetering life sciences data with reference to earth- and space-based systems. Author

N63-23088 Radio Corp. of America, Camden, N.J. Electronic Products Div.

INVESTIGATION OF IMAGE ANALYSIS TECHNIQUES

M. B. Herscher and T. P. Kelley Wright-Patterson AFB, Ohio, AF Avionics Lab., Sept. 1963 87 p 4 refs

(Contract AF 33(616)-7734)

(ASD-TDR-63-866)

The objective of this program was to construct a functional model of the frog retina in order to evaluate its performance with respect to operational requirements of the Air Force. The features abstracted both by the frog and the model are the presence and location of edges, moving dark convexities, changing contrast, and dimming. The model was designed so that processing takes place in logic layers (or planes) analogous to those found in the brain of the frog. Although parallel processing is used in the model, a minimum of physical interconnections between processing planes was required. This simplification was accomplished by the use of neon-lamp photoconductor-cell pairs. These pairs were coupled by the light emitted from a neon lamp on one processing plane to a photoconductor located on the following processing plane. The neon lamps also serve as threshold elements for logic functions. Author

N63-23117 Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.

USE OF VORTEX TUBE FOR COOLING WEARERS OF INDUSTRIAL PROTECTIVE CLOTHING

J. M. Alexander, J. J. Croley, Jr., and R. R. Messick Oct. 1963 31 p 71 refs

(Contract AT(07-2)-1)

(DP-861) OTS: $0.50

A Ranque-Hilsch vortex tube worn as a portable refrigerator can satisfactorily cool compressed air for personnel wearing industrial protective clothing. It is light and small, and can be strapped to the body where it does not interfere with physical movements. The tube operates on 20 to 25 cfm of compressed air at 80 to 100 psig and delivers from 15 to 18 cfm of air, cooled 50° to 60° F below the inlet air temperature. Author

N63-23180 Naval Radiological Defense Lab., San Francisco, Calif.

INDUCTION OF HOMOGRAFT TOLERANCE IN SUBLETHALLY X-IRRADIATED ADULT MICE

W. E. Davis and L. J. Cole Aug. 19, 1963 12 p 12 refs

(USNRDL-TR-668)

Allogeneic mice which share the same H-2 locus, but differ at other histocompatibility loci, have been used with some success. A tolerant state has been produced in CBA ($H\text{-}2^k$) mice by first exposing them to sublethal X-radiation (500 rad) or urethan-treatment coupled with irradiation, and then injecting C3H ($H\text{-}2^k$) spleen (18×10^6) and/or bone marrow (42×10^6) cells within 3 days postirradiation. These mice have retained subsequent C3H skin homografts (over 165 days) but have rejected BALB/c skin grafts ($H\text{-}2^d$) within 33 days. On the other hand, irradiated and urethan-treated controls, uninjected or injected with X-ray inactivated (2000 rad *in vitro*) C3H cells, rejected both C3H and BALB/c homografts by 70 days. The significance of these results with regard to the requirement of cellular chimerism for the induction and maintenance of homograft tolerance is discussed. Author

N63-23187 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Tech. Div.

CERTAIN VARIATIONS IN CARBOHYDRATE METABOLISM IN MONKEYS WITH ACUTE RADIATION SICKNESS

L. N. Polikarpova and A. Ya. Shulyatikova July 17, 1963 12 p 29 refs Transl. into ENGLISH from Radiobiologiya (Moscow), v. 2, no. 3, 1962 p 390–394

(FTD-TT-63-641/1+2+4)

Changes in carbohydrate metabolism in monkeys subjected to a single 700-r dose of X-irradiation were investigated. Two or three days after irradiation, the synthetic processes were enhanced, lactic-acid blood levels dropped 30% to 40% below normal, and the glycogen content of the skeletal muscle increased with a simultaneous fall in liver, brain, and blood glycogen. In the preterminal period, five to eight days postirradiation, the glycogen content in the liver and skeletal muscles gradually dropped with an associated increase in blood lactic acid and sugar levels, indicating a predominance of decomposition processes, a decrease of oxidative processes, and liver disorders. M.P.G.

N63-23239 AiResearch Mfg. Co., Los Angeles, Calif.

PROBLEMS AND PROGRESS WITH LONG-DURATION LIFE-SUPPORT SYSTEMS

J. L. Mason and W. L. Burriss *In* AIAA 2nd Manned Space Flight Meeting [1963] p 329–340 refs (See N63-23201 24-01)

This paper discusses recent progress and present status, and presents many of the development problems that must be solved to achieve a completely integrated and reliable life-support system for long-duration space missions. Areas of life-support system problems discussed include: (1) material balances; breathing gas, water, carbon dioxide, atmospheric fluid storage, and oxygen recovery, (2) power penalties, (3) carbon dioxide removal, (4) oxygen recovery by methanation of carbon dioxide, (5) methane pyrolysis, (6) oxygen recovery by carbon dioxide reduction, (7) oxygen recovery by Fischer–Tropsch process, (8) trace contaminant control, and (9) waste management. P.V.E.

N63-23272 Joint Publications Research Service, Washington, D.C.

EXCERPTS FROM DOKLADY AKADEMII NAUK SSSR (REPORTS OF THE ACADEMY OF SCIENCES USSR) [VOLUME 142, NUMBER 3, 1962]

July 9, 1962 19 p Transl. into ENGLISH of three articles from the above-named Soviet journal
(JPRS: 14415)

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1. THE IMPORTANCE OF FAT RESERVES OF THE CELL FOR ITS REACTIVATION FOLLOWING RADIATION INJURY V. M. Alekseyeva and M. N. Meysel' p 1-6 refs (See N63-23273 24-16)

2. RELATIVE BIOLOGICAL EFFECTIVENESS (RBE) OF 660 MEV PROTONS E. B. Kurlyandskaya, G. A. Avrunina, V. L. Pomomareva, V. I. Fedorova, B. I. Yanovskaya, and S. P. Yarmonenko p 7-13 (See N63-23274 24-16)

3. REDUCTION OF THE DEGREE OF INJURY OF DNA MOLECULES UNDER THE EFFECT OF RADIATION IN THE PRESENCE OF PROPYLGALLATE N. V. Nikolayeva, K. Ye. Kruglyakova, N. A. Kiselev, B. K. Vaynshteyn, and N. M. Emanuel' p 14-17 refs (See N63-23275 24-16)

N63-23273 Joint Publications Research Service, Washington, D.C.

THE IMPORTANCE OF FAT RESERVES OF THE CELL FOR ITS REACTIVATION FOLLOWING RADIATION INJURY

V. M. Alekseyeva and M. N. Meysel' *In its* Excerpts from Dokl. Akad. Nauk SSSR [Vol. 142, no. 3, 1962] p 1-6 refs (See N63-23272 24-16)

Cultures of yeast organisms of *Endomyces magnusii* and *Saccharomyces vini* Megri strain 139-B were used in these experiments. The yeast organisms were cultivated on a modified artificial Rider nutrition medium. Saccharose was used as a source of carbohydrate nutrition, and glycocoll as nitrogen nutrition. Considerable variations in the cellular fat reserves were obtained by changing the quantitative interrelations of the sources of carbohydrate, nitrogen, and phosphorus nutrition in the nutritive medium. In order to obtain yeast cells rich in reserve fat, the content of sugar in the nutritive medium was drastically increased while the content of glycocoll and phosphorus was reduced. The irradiation conditions were as follows: 210 kw, 15 ma, dose strength 3760/min without filter. Results indicated that: (1) cells containing higher quantities of reserve fat had a higher radioresistance than those with low fat reserve; (2) reactivation of such cells proceeded at a higher level than that of cells with lower quantities of reserve fat. This is particularly manifested during the first days of the reactivation process. I.v.L.

N63-23274 Joint Publications Research Service, Washington, D.C.

RELATIVE BIOLOGICAL EFFECTIVENESS (RBE) OF 660 MEV PROTONS

E. B. Kurlyandskaya, G. A. Avrunina, V. L. Pomomareva, V. I. Fedorova, B. I. Yanovskaya, and S. P. Yarmonenko *In its* Excerpts from Dokl. Akad. Nauk SSSR [Vol. 142, no. 3, 1962] p 7-13 (See N63-23272 24-16)

The relative biological effectiveness (RBE) of 660 Mev protons on nonpedigreed white male mice and white male rats was investigated. The protons were ejected by pulses of 100 v/sec, of 200 to 400 micron/sec each. The mice were irradiated with doses from 260 to 44,800 r. The rats were irradiated with doses from 300 to 1600 r. Results are as follows: (1) Total irradiation of mice and rats with high-energy protons leads to the development of typical acute radiation sickness. (2) The sex glands proved to be the most sensitive to this type of radiation (RBE ~ 1). (3) The effect of protons on the hemopoietic system and on the survival of the animals is considerably lower (RBE 0.5). (4) The carcinogenic effect of high-energy protons, according to preliminary data, equals or exceeds that of X-rays. These results confirm the importance of the study of RBE of various types of radiation not only in regard to the general reactions of the organisms and acute manifestations of the affection, but also in regard to the reactions of individual systems and at various periods following exposure. I.v.L.

N63-23275 Joint Publications Research Service, Washington, D.C.

REDUCTION OF THE DEGREE OF INJURY OF DNA MOLECULES UNDER THE EFFECT OF RADIATION IN THE PRESENCE OF PROPYLGALLATE

N. V. Nikolayeva, K. Ye. Kruglyakova, N. A. Kiselev, B. K. Vaynshteyn, and N. M. Emanuel' *In its* Excerpts from Dokl. Akad. Nauk SSSR [Vol. 142, no. 3, 1962] p 14-17 refs (See N63-23272 24-16)

The deoxyribonucleic acid (DNA) preparations investigated were obtained from the spleen of rats. Propyl gallate (PG) was added to a portion of the preparations. Irradiation was carried out on a near-focus X-ray BF-2 apparatus (75 kv, 8 ma, with a molybdenum anode without a filter). The dose strength was 135,000 r/m. The dosages were 66,000, 168,000, and 336,000 r. Results are as follows: (1) For a 66,000 r dose without PG, the extent of the damage to DNA molecules (as per the magnitude of the characteristic viscosity) reached 50%. (2) For a 168,000 r dose, without PG, the damage to the DNA molecules was 75%. (3) For a dose of 336,000 r, without PG, the damage to the DNA molecules was almost 100%. (4) In all cases of added PG, a 40% to 50% protection of DNA molecules from damage was obtained. I.v.L.

N63-23291 Joint Publications Research Service, Washington, D.C.

STUDIES IN THE FIELD OF MEDICAL RADIOLOGY – USSR

Sept. 25, 1963 91 p refs Transl. of selected articles from Med. Radiol. (Moscow), v. 8, no. 6, June 1963
(JPRS-21214; OTS-63-31821) OTS: $2.25

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1. THE MECHANISM OF ACTION OF ANTIRADIATION AGENTS V. I. Kuznetsov and M. S. Kushakovskiy p 1-9 (See N63-23292 24-16)

2. ANALYSIS OF THE ACTION OF RADIOPROTECTIVE AGENTS FROM THE ASPECTS OF THEIR PRACTICAL APPLICATION S. P. Yarmonenko p 10-25 refs (See N63-23293 24-16)

3. POTENTIOMETRIC DETERMINATION OF THE EFFECTIVENESS OF CYSTEAMINE PROTECTION ON MICE G. V. Sumarukov and Yu. B. Kudryashov p 26-31 refs (See N63-23294 24-16)

4. THE EFFECT OF UNITHIOLE ON THE KIDNEY FUNCTION OF DOGS INJURED BY IONIZING RADIATION Z. I. Poluboyarinova p 32-40 refs (See N63-23295 24-16)

5. TRANSFORMATION OF HEMOPOIETIC CELLS OF TRANSPLANTED ALLOGENOUS BONE MARROW INTO IMMUNOLOGICALLY COMPETENT CELLS IN IRRADIATED DOGS I. L. Chertkov, M. N. Novikova, L. S. Rogacheva, L. L. Shepshelevich et al p 41-54 refs (See N63-23296 24-16)

6. STUDY OF THE DYNAMICS OF ERYTHROPOIESIS BY MEANS OF THYMIDINE-H^3, FE^{59} AND ERYTHROPOIETIN G. I. Kozinets, M. Tyubiana, and E. Frindel' p 55-59 refs (See N63-23297 24-16)

7. THE MECHANISM OF THE THERAPEUTIC EFFECT OF BONE MARROW TRANSFUSIONS IN THE TREATMENT OF RADIATION SICKNESS M. P. Bogoyavlenskaya, Ye. A. Zotikov, A. V. Ilyukhin, G. I. Kozinets, L. I. Krasyukova et al p 60-67 refs (See N63-23298 24-16)

8. THE EFFECT OF HOMOLOGOUS BONE MARROW TRANSPLANTATION ON CERTAIN REACTIVITY INDICES AND THE SURVIVAL OF LETHALLY IRRADIATED RATS I. G. Veksler p 68–74 refs (See N63-23299 24-16)

9. THE RECEPTION OF IONIZING RADIATION BY THE ORGANISM Reviews Yu. G. Grigor'yev and L. N. Kvasnikova p 75–87 refs (See N63-23300 24-16)

N63-23292 Joint Publications Research Service, Washington, D.C.

THE MECHANISM OF ACTION OF ANTIRADIATION AGENTS

V. I. Kuznetsov and M. S. Kushakovskiy *In its* Studies in the Field of Med. Radiol.–USSR Sept. 25, 1963 p 1–9 Transl. into ENGLISH from Med. Radiol. (Moscow), v. 8, no. 6, June 1963 (See N63-23291 24-16) OTS: $2.25

Investigations relative to the influence of cystamine hydrochloride and S,-beta-aminoethylisothiuronium hydrobromide on the oxygen balance in the human organism were undertaken. Cystamine in peroral doses of 200 to 600 mg causes a rise of the basal metabolism, increased oxygen consumption in the lungs, intensified respiration of erythrocytes (in the presence of glucose), and reduction of methemoglobin. S,-beta-aminoethylisothiuronium in similar doses causes a drop of the basal metabolism and a diminution of the coefficient of oxygen consumption in the lungs. S-beta-aminoethylisothiuronium, in contrast to cystamine, penetrates the erythrocyte membrane weakly. Author

N63-23293 Joint Publications Research Service, Washington, D.C.

ANALYSIS OF THE ACTION OF RADIOPROTECTIVE AGENTS FROM THE ASPECTS OF THEIR PRACTICAL APPLICATION

S. P. Yarmonenko *In its* Studies in the Field of Med. Radiol.–USSR Sept. 25, 1963 p 10–25 refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 8, no. 6, June 1963 (See N63-23291 24-16) OTS: $2.25

In experiments on mice subjected to whole-body, single or fractional Co^{60} gamma-irradiation, the relation between the quantity of antiradiation agents (cystamine, cysteamine, AET, 5-methoxytryptamine), radiation dose, and protective effect was investigated. It was found that no direct quantitative correlations exist between the content of the preparation in the organism and the value of the absorbed dose. Administration of half of the optimal protective dose is attended by a decrease of the protective effect, whereas in reduction of the quantity of the preparation down to 1/3 of the optimal dose it disappears completely. Author

N63-23294 Joint Publications Research Service, Washington, D.C.

POTENTIOMETRIC DETERMINATION OF THE EFFECTIVENESS OF CYSTEAMINE PROTECTION ON MICE

G. V. Sumarukov and Yu. B. Kudryashov *In its* Studies in the Field of Med. Radiol.–USSR Sept. 25, 1963 p 26–31 refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 8, no. 6, June 1963 (See N63-23291 24-16) OTS: $2.25

During X-ray irradiation of mice, a direct relation was revealed between the protective effect of cysteamine and the degree of changes in the level of the redox potential of mouse muscle measured in vivo. The protective action of cysteamine was most pronounced one hour after intraperitoneal injection. At the time the redox potential of tissues showed the greatest reduction. Author

N63-23295 Joint Publications Research Service, Washington, D.C.

THE EFFECT OF UNITHIOLE ON THE KIDNEY FUNCTION OF DOGS INJURED BY IONIZING RADIATION

Z. I. Poluboyarinova *In its* Studies in the Field of Med. Radiol.–USSR Sept. 25, 1963 p 32–40 refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 8, no. 6, June 1963 (See N63-23291 24-16) OTS: $2.25

Investigations established that the employment of unithiole in Po^{210}-induced radiation sickness in animals increases the life expectation and retards the development of renal function disorders at the early periods of radiation sickness. However, under the influence of unithiole, there is a greater accumulation of the radioactive substance in the kidneys leading into nephrosclerosis. In experiments staged on healthy animals, the use of unithiole during the first 4 to 5 days causes an inhibition of diuresis and only in the subsequent days does it cause polyuria. The referred to changes are associated with the biphasic action of unithiole on the acid-base metabolism and function of the kidneys (renal blood circulation, glomerular filtration, canalicular reabsorption). Author

N63-23296 Joint Publications Research Service, Washington, D.C.

TRANSFORMATION OF HEMOPOIETIC CELLS OF TRANSPLANTED ALLOGENOUS BONE MARROW INTO IMMUNOLOGICALLY COMPETENT CELLS IN IRRADIATED DOGS

I. L. Chertkov, M. N. Novikova, L. S. Rogacheva, L. L. Shepshelevich et al *In its* Studies in the Field of Med. Radiol.–USSR Sept. 25, 1963 p 41–54 refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 8, no. 6, June 1963 (See N63-23291 24-16) OTS: $2.25

In experiments on dogs subject to superlethal irradiation (1,000 r), it was demonstrated that allogenous bone marrow transplantation does not produce a therapeutic effect, inasmuch as normal hemopoiesis of the transplant is preserved only for 3 to 4 days. Starting from the 5th to 6th day, there takes place transformation of hemopoietic cells into immunologically competent cells, which are the morphological basis of the "transplant against host" reaction. The transformation of hemopoiesis is associated with the antigenic differences of the donor and recipient, since during repopulation of the bone marrow from the screened extremities in active proliferation, no hyperbasophilic cells are formed, and the myeloid hemopoiesis is preserved. The formation therefrom of hyperbasophilic cells and lymphocytes is due to transformation of hemocytoblasts, and not immunologically competent cells of the bone marrow. Author

N63-23297 Joint Publications Research Service, Washington, D.C.

STUDY OF THE DYNAMICS OF ERYTHROPOIESIS BY MEANS OF THYMIDINE-H^3, FE^{59} AND ERYTHROPOIETIN

G. I. Kozinets, M. Tyubiana, and E. Frindel' *In its* Studies in the Field of Med. Radiol.–USSR Sept. 25, 1963 p 55–59 refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 8, no. 6, June 1963 (See N63-23291 24-16) OTS: $2.25

Dynamic investigations were conducted for the erythropoiesis in mice using labelled precursors of DNA (thymidine-H^3) and hemoglobin (Fe^{59}), and experimental polycythemia, with the subsequent stimulation of the erythropoiesis by introducing erythropoietin. It was determined that the mean time necessary for differentiation of the reticular cell of bone marrow until the appearance of reticulocytes in the peripheral blood is 30 to 48 hours. Author

N63-23298 Joint Publications Research Service, Washington, D.C.

THE MECHANISM OF THE THERAPEUTIC EFFECT OF BONE MARROW TRANSFUSIONS IN THE TREATMENT OF RADIATION SICKNESS

M. P. Bogoyavlenskaya, Ye. A. Zotikov, A. V. Ilyukhin, G. I. Kozinets, L. I. Krasyukova et al *In its* Studies in the Field of Med. Radiol.-USSR Sept. 25, 1963 p 60-67 refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 8, no. 6, June 1963 (See N63-23291 24-16) OTS: $2.25

Experimental and clinical data are presented, which demonstrate that the effect of bone marrow in chronic radiation injury is of a biphase nature. In the first phase, an inhibition of hematopoiesis is noted, whereas in the subsequent period there is seen a rather intensive and stable stimulation. It was observed that the stimulating effect of bone marrow becomes manifest during the period of disappearance of its cellular elements from the blood of recipients, i.e. 5 to 10 days after the injection.
Author

N63-23299 Joint Publications Research Service, Washington, D.C.
THE EFFECT OF HOMOLOGOUS BONE MARROW TRANSPLANTATION ON CERTAIN REACTIVITY INDICES AND THE SURVIVAL OF LETHALLY IRRADIATED RATS
I. G. Veksler *In its* Studies in the Field of Med. Radiol.-USSR Sept. 25, 1963 p 68-74 refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 8, no. 6, June 1963 (See N63-23291 24-16) OTS: $2.25

The effect of homologous bone marrow transplantation on certain reactivity indices, and the survival of lethally irradiated rats were investigated. Results indicate that: (1) repeated intraveneous transplantation of homologous bone marrow mitigates the course of radiation sickness and protects 35% of the white rats exposed to X-irradiation in a lethal dose (650 r) from death within a period of 30 days, as against 100% mortality of the control animals; (2) the recovery of the phagocytic activity of leucocytes, considerably injured as the result of radiation, occurs along with the normalization of the morphological content of the blood, under the influence of bone marrow transplantation; (3) transplantation of homologous bone marrow contributes to the restoration of the carcinolytic activity of blood serum; this activity is completely suppressed during the period of the climax of radiation sickness in lethally irradiated rats; (4) the data obtained attest to the fact that bone marrow transplantation is an important means of increasing the reactivity of the irradiated organism. I.v.L.

N63-23300 Joint Publications Research Service, Washington, D.C.
THE RECEPTION OF IONIZING RADIATION BY THE ORGANISM Reviews
Yu. G. Grigor'yev and L. N. Kvasnikova *In its* Studies in the Field of Med. Radiol.-USSR Sept. 25, 1963 p 75-87 refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 8, no. 6, June 1963 (See N63-23291 24-16) OTS: $2.25

The perception of ionizing radiation by the organism is reviewed. Experimental evidence indicates that this radiation apparently plays the role of a factor which forms behavioral reactions only by means of an indirect effect. The primary effect apparently consists of physicochemical injuries to cell structures, and impairment of the most radiosensitive intrinsic biochemical processes. Thus, the organism cannot differentiate ionization radiation as a specific stimulus for the behavioral reactions, i.e., ionization radiation cannot be an adequate stimulus for these reactions. These findings indicate that there is no specific receptor for ionizing radiation. I.v.L.

N63-23339 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.
PHOTOSTRESS AND FLASH BLINDNESS IN AEROSPACE OPERATIONS
Sanford L. Severin Sept. 1963 11 p 5 refs
(SAM-TDR-63-67)

The hazard of flash blindness to the success of an aerospace mission is well recognized. Until recently, there has been a paucity of information on the effects of short-duration, high-intensity light flashes on visual performance. This paper presents the results of several experiments designed to study the severity of the visual disturbance from short-duration high-intensity light flashes. Subjects have been exposed to bright flashes that illuminate the cornea with intensities up to 242,000 lux (about twice the illumination that an unprotected astronaut would be exposed to on an earth orbit). An analysis has been made of the effect of drug-induced miosis upon the time required for recovery. The relevance of the information derived from this work to problems of space and nuclear operations is mentioned, and the operational significance is implied.
Author

N63-23372 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.
THE PHOTOSTRESS TEST FOR THE EVALUATION OF MACULAR FUNCTION
Sanford L. Severin et al June 1963 12 p 11 refs
(SAM-TDR-63-47)

A technique is presented for evaluation of macular performance that is based on precisely measuring the time required for a patient to recover sufficient visual function to perform defined visual tasks after he has been dazzled with an intense flash of light. The process of delivering photic energy to the retina has been termed photostress and the term photofatigue has been proposed to graphically describe the condition of the retina after photostress. Cases studied are presented that will aid in the evaluation of this test in the study of macular disease, and a possible mechanism is discussed.
Author

N63-23395 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
COMPARATIVE INVESTIGATION OF THE FORMULATION OF PHEOPHYTINES FROM CHLOROPHYLL AND ITS ANALOGUES IN DARKNESS AND UPON ILLUMINATION
A. A. Krasnovski and Ye. V. Pakshina Sept. 9, 1963 9 p 7 refs Transl. into ENGLISH from Doklady, Akad. Nauk SSSR, (Moscow), v. 148, no. 4, 1963 p 935-938
(FTD-TT-63-866/1+2)

The pheophytinization reaction was investigated in aqueous (10%H_2O) and aqueous pyridine (10%H_2O) in the presence of oxalic acid or hydrochloric acid in Turnberg tubes, adapted for spectrometric measurements. The illumination intensity was about 10^4erg/cm^2. The rate of pheophytinization was observed by measuring the absorption spectra on spectrophotometers SF-5 and SF-10 by the drop in characteristics absorption maxima of the basic pigments and by the appearance of pheophytin maxima. In pyridine solutions of chlorophyll A, chlorophyll B, and protochlorophyll, the accelerating effect of light on pheophytinization was detected. At the same time, there was generally no dark pheophytinization of these pigments with oxalic acid when the pyridine solutions remained in darkness. However, when these same solutions were illuminated, the pheophytinization reaction was actually completed within 10 to 15 min. When hydrochloric acid was used in these same reactions instead of oxalic acid, pheophytinization was much slower than in the presence of oxalic acid; the reaction was practically completed within 40 to 45 minutes. Pheophytinization of bacterioviridin was rapid in darkness and under conditions of illumination. I.v.L.

N63-23420 North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
DATA PROCESSING IN THE LIFE SCIENCES: A SURVEY
Feb. 20, 1963 127 p 492 refs Covers 1950–Dec. 1962 (SID-63-200)

References were taken from the international literature in areas of biomedical uses and applications of computers. The years covered are 1950 to December 1962. Author

N63-23453 Princeton U., N.J.
SPACE AND THE LIFE SCIENCES
Colin S. Pittendrigh *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 283–296 (See N63-23436 24-01)
(Lecture 19)

The prospects for a major breakthrough in the life sciences due to the new space age technology are considered to depend upon such long-shots as the discovery of extraterrestrial life, whereas the real impact of the space program is seen to lie in the previously ignored fields of sensory and environmental physiology. The man-in-space programs, with their emphasis on providing the essentials of man's terrestrial environment within a space cabin, have already given great impetus to ground-based physiology. Optimum conditions of variables like temperature, moisture, oxygen, and carbon dioxide have been established with some precision; some second-order environmental variables which are still poorly understood are discussed. These include barometric pressure, magnetic fields, radiofrequency fields, low-voltage dc fields, navigation and homing instincts, periodic daily rhythms, and gravitational fields. Spacecraft can be considered as apparatus for studying these effects as well as the stimulus provoking renewed interest in such physiological studies. M.P.G.

N63-23454 California U., Berkeley
LIFE BEYOND THE EARTH
Carl Sagan *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 297–310 (See N63-23436 24-01)
(Lecture 20)

The interrelated questions of extraterrestrial life and the origin of life on Earth are considered. A theory of the origin of life in the primitive oceans is reviewed, and the laboratory recreation of life is regarded as a likely possibility. The primitive environments of the other planets are expected to have been similar to the primitive environment of the Earth. Information on the present atmospheric and surface conditions of Venus, Mars, the Moon, and the Jovian planets is reviewed and related to the possibility of existence of life based on organic matter. The existence of life based on some other kind of chemistry is beyond comprehension at present. Speculation on extraterrestrial life has been popular over the years, but the prospect of actual experimentation to solve this question belongs to this generation. The importance of sterilizing the interiors of all space probes in order to prevent contamination of extraterrestrial areas with terrestrial microorganisms is stressed. M.P.G.

N63-23492 Joint Publications Research Service, Washington, D.C.
EFFECTIVENESS OF ELECTRIC SLEEP TREATMENT IN CERTAIN OCCUPATIONAL DISEASES
S. P. Shatrova (Inst. of Labor Hyg. and Occupational Diseases) Nov. 4, 1963 9 p Transl. into ENGLISH from Gigena Truda i Profess. Zabolevaniia (Moscow), v. 7, no. 9, Sept. 1963 p 45–47
(JPRS-21712; OTS-63-41052) OTS: $0.50

Impulse-current electric sleep treatments were used on 40 patients, of whom 16 suffered with chronic tetraethyl lead poisoning, 14 with chronic lead poisoning, and 10 with vibration sickness. A course of treatment consisted of 10 to 15 treatments lasting from 15 minutes to 1 hour and 30 minutes. The frequency and intensity of current were selected individually, and amounted to 7 to 20 impulses per second at 0.5 to 0.7 ma. Effects noted in the patients included the following: From the 5th to 7th treatment, the patients, as a rule, fell asleep during the procedure, but the sleep was not deep enough. With subsequent treatment, sleep became deeper. Dreams appeared to 24 patients during the treatment. The treatments appeared to be effective to some degree in 39 of the patients. The nocturnal sleep of all patients improved, and after 3 to 6 treatments, sleep became more prolonged, less shallow, the process of falling asleep accelerated, interrupted sleep decreased, and the sleep became "refreshing." It is concluded that the method of electric sleep can be recommended in occupational-disease clinics for treatment of poisonings and occupational diseases in which the clinical picture of neurotic reactions predominates. P.V.E.

N63-23506 Library of Congress, Washington, D.C. Aerospace Information Div.
SOVIET BIOMEDICAL MONITORING IN SPACE FLIGHT METHODS, TECHNIQUES, AND EQUIPMENT – A COLLECTION OF ABSTRACTS
Mar. 27, 1963 41 p refs Review of one article in Etudes sovie-tiques and 10 articles in Pervyye kosmicheskiye polety cheloveka (First space flights of man) and Problemy kosmicheskoy biologii (Problems of space biology)
(AID Rept. P-63-42) OTS: $4.60 ph, $1.43 mf

A collection of abstracts is presented concerning Soviet biomedical monitoring in spaceflight methods, techniques, and equipment. C.L.W.

N63-23514 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.
PRELIMINARY STUDIES ON LIGHT-INDUCED CARBON MONOXIDE IN CLOSED ENVIRONMENTS
Syrrel S. Wilks Sept. 1963 10 p 8 refs
(SAM-TDR-63-65)

This paper presents experimental data concerning the effects of solar light upon certain classes of organic substances which may be components of the sealed environment of space vehicles. Many materials such as organic plastics, pigments, insulating material, etc., when exposed to light in the presence of oxygen, liberate a number of toxic end products such as carbon monoxide, aldehydes, acids, and certain hydrocarbons. In a sealed environment these agents may, unless removed, reach levels toxic to human beings during a long sojourn in a sealed system. Author

N63-23521 Aerospace Medical Center. School of Aerospace Medicine, Brooks AFB, Tex.
THE INTERACTION BETWEEN ACTIVE SODIUM TRANSPORT AND ACTIVE SUGAR TRANSPORT IN THE ISOLATED RABBIT ILEUM
Stanley G. Schultz and Ralph Zalusky Repr. from Biochim. Biophys. Acta, v. 71, 1963 p 503–505 12 refs
(NASA Order R-44)

New Zealand white rabbits were anesthetized. After opening the abdomen, the terminal 5 cm of ileum was excised and rapidly opened along the mesenteric border. The exposed mucosal surface was then rinsed free of intestinal contents and the tissue clamped between two lucite chambers. Perfusion and aeration of each surface was accomplished by means of a water-jacketed, gas-lifting circulating system employing a 95% O_2–5% CO_2 gas mixture. The salt composition of the bathing

solution was: 137 mM NaCl, 5.0 mM KCl, 2.5 mM $CaCl_2$, 2.2 mM $MgCl_2$, 1.1 mM Na_2HPO_4, 0.2 mM KH_2PO_4, and 2.5 mM $NaHCO_3$. The solutions were maintained at 37° C. The transmural potential difference and the short-circuit current were determined. It was observed that the short-circuit current is markedly stimulated by the addition of an actively transported, nonmetabolized sugar to the solution bathing the mucosal surface. This clearly establishes an interaction between the mechanisms responsible for the active transport of Na^+ and sugar. These results further indicate that in addition to the role of glucose as a source of metabolic energy for active-transport processes, the active transport of glucose per se stimulates active Na^+ transport in the isolated rabbit ileum. I.v.L.

N63-23530 Northrop Corp., Hawthorne, Calif. Space Labs.
INVESTIGATION OF PEROGNATHUS AS AN EXPERIMENTAL ORGANISM FOR RESEARCH IN SPACE BIOLOGY
Final Report
R. G. Lindberg, D. F. Mitchell, J. J. Gambino, R. M. Chew, and J. W. Towner Aug. 1963 133 p 21 refs
(NASA Contract NASr 91)
(NASA CR-51643; NSL 62-125-5) OTS: $10.50 ph, $4.19 mf

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N63-23531 Northrop Corp., Hawthorne, Calif.
METABOLIC CHARACTERISTICS OF POCKET MICE (PEROGNATHUS) ESPECIALLY THE LITTLE POCKET MOUSE (P. LONGIMEMBRIS)
R. M. Chew, R. G. Lindberg and P. Hayden *In its* Invest. of Perognathus as an Exptl. Organism for Res. in Space Biol. Aug. 1963 p 5-59 25 refs (See N63-23530 24-16) OTS: $10.50 ph, $4.19 mf

Metabolic experiments were conducted on seven species of pocket mice (genus *Perognathus*) for: (1) determining the oxygen requirements of pocket mice in both normal and hypometabolic states; (2) studying the relationships of body temperatures to metabolic rates under different conditions; and (3) studying the physiology of pocket mice under conditions which induce hibernation, and ways of artificially inducing prolonged hibernation. The data obtained are adequate for predicting the logistics requirements of *Perognathus longimembris* for space biopack experiments. I.v.L.

N63-23532 Northrop Corp., Hawthorne, Calif.
RESPONSE OF THE POCKET MOUSE TO IONIZING RADIATION
J. J. Gambino and R. G. Lindberg *In its* Invest. of Perognathus as an Exptl. Organism for Res. in Space Biol. Aug. 1963 p 61–76 10 refs (See N63-23530 24-16) OTS: $10.50 ph, $4.19 mf

Several hundred pocket mice representing two species, *Perognathus longimembris* and *P. formosus*, were administered single whole-body X- and gamma-radiation. Exposure doses of 400, 600, 800, 1000, 1200, 1400, 1600, 1800, and 2000 r were used. Radiation at the highest dose levels only (>1200 r) resulted in significant numbers of acute (30-day) deaths. The $LD_{50/30}$ for pocket mice in this experiment (1280 r *P. formosus*: 1520 r *P. longimembris*) is two to three times that reported for related mammalian forms. Postirradiation hematological changes as evidenced by total and differential blood counts, hematocrits, hemoglobins, etc., corroborate the extreme radiation insensitivity reflected in survival curves. At 1400 r the magnitude of the leucocyte depression is of the same order as that observed in other rodents receiving 400 to 500 r. Author

N63-23533 Northrop Corp., Hawthorne, Calif.
METABOLIC RATES OF IRRADIATED PEROGNATHUS LONGIMEMBRIS
P. Hayden and J. J. Gambino *In its* Invest. of Perognathus as an Exptl. Organism for Res. in Space Biol. Aug. 1963 p 77-82 3 refs (See N63-23530 24-16) OTS: $10.50 ph, $4.19 mf

Twelve adult *Perognathus longimembris* were administered a 1400-r total body dose of Co^{60} radiation. During the postirradiation periods for this portion of the experiment (two weeks and 79 days), oxygen consumption data suggest that the metabolic level of sublethally irradiated pocket mice, when maintaining normal body temperature, was within the normal limits established for these mice at 22° C. During the first two-weeks study, a diurnal rhythm ranging from normal metabolism to torpor was evidenced. There was an overall total weight loss of 10% during the first week, 5% of which was regained during the second week. The total weight loss during the entire period was less than 6%. Of the four animals that showed a well-defined diurnal torpor during the first two-week study, only two had any indication of a timed sequence when tested again at 79 days postirradiation. When these four animals were exposed to ambient temperatures varying from 5° to 35° (50 days postirradiation), there was an indication of deviation from the normal oxygen curve at the lower temperatures. The increase in oxygen consumption was approximately 17% at 0° C. I.v.L.

N63-23534 Northrop Corp., Hawthorne, Calif.
BLOOD VALUES OF POCKET MICE (PEROGNATHUS)
J. J. Gambino and N. K. Miyahara *In its* Invest. of Perognathus as an Exptl. Organism for Res. in Space Biol. Aug. 1963 p 84-94 8 refs (See N63-23530 24-16) OTS: $10.50 ph, $4.19 mf

Total erythrocyte counts, total leucocyte counts, hematocrit determination, and differential counts were made on both male and female *Perognathus longimembris* tail blood. Mice were sampled during a nine-month period. Mean erythrocyte counts ranged from 11.9×10^6 cells/mm^3 to 15.5×10^6 cells/mm^3.

Mean leucocyte counts were considerably more variable, ranging from 6.6×10^6 to 32.4×10^3 cells/mm^3. The high mean value (32.4 ± 24.0) was the second bleeding for these animals, and there is a suggestion of infection due to the prior tail cut. Hematocrits of *Perognathus* tail blood are high. Mean hematocrit values range from 52 to 59%. The mean corpuscular volume was 41.5 cubic microns. Differential counts of blood smears indicate that there are no major morphological differences between pocket-mouse blood cells and those of other animals. The baseline values of *Perognathus* blood obtained in this study have been used to assess the effects of exposure to ionizing radiation. I.v.L.

N63-23535 Northrop Corp., Hawthorne, Calif.
KARYOTYPE ANALYSIS OF PEROGNATHUS SPECIES
D. F. Mitchell and J. W. Towner *In its* Invest. of Perognathus as an Exptl. Organism for Res. in Space Biol. Aug. 1963 p 95–106 3 refs (See N63-23530 24-16) OTS: $10.50 ph, $4.19 mf

The mice were sacrificed by suffocation, and chromosome analyses were from bone marrow, kidney, spleen, heart, and lung tissues. The chromosome preparations of the bone-marrow cells were made without prior *in vitro* culture or *in vivo* colchicine administration. The karyotypes of seven species of pocket mice are described. The diploid chromosome number ranges from 36 to 58 in various species. The ratios of metacentric to acrocentric chromosomes and the chromosome number and morphology are highly variable among the species. Karyotypic divergence is, however, generally consistent with the taxonomy based on morphological characters. I.v.L.

N63-23536 Northrop Corp., Hawthorne, Calif.
BREEDING OF HETEROMYID RODENTS
T. Tagami *In its* Invest. of Perognathus as an Exptl. Organism for Res. in Space Biol. Aug. 1963 p 107–109 1 ref (See N63-23530 24-16) OTS: $10.50 ph, $4.19 mf

An annotated bibliography of the breeding of heteromyid rodents is presented. I.v.L.

N63-23537 Northrop Corp., Hawthorne, Calif.
APPLICATION TO SPACE BIOLOGY RESEARCH
R. G. Lindberg and D. F. Mitchell *In its* Invest. of Perognathus as an Exptl. Organism for Res. in Space Biol. Aug. 1963 p 111–117 (See N63-23530 24-16) OTS: $10.50 ph, $4.19 mf

A proposed experiment for studying the effect of extraterrestrial residence on the circadian metabolic rhythm of pocket mice (*Perognathus longimembris*) is described. Four units of 8 mice each (*P. longimembris*) are to be subjected to a minimum of two weeks in orbit. The first week, at least, is to be in a weightless condition. Artificial gravitational force will be provided during the second week, provided that anomalies in the rhythms become apparent during the first week. Since availability of food is known to influence the depth of hypometabolism, the following feeding schedule will be maintained: unit one, fed both first and second week; unit two and three, not fed first week, fed second week; unit four, fed first week, not fed second week. I.v.L.

N63-23538 Northrop Corp., Hawthorne, Calif.
LIFE SUPPORT SYSTEM FOR THE STUDY OF BIOLOGICAL RHYTHMS IN POCKET MICE—A PRELIMINARY DESIGN
W. Kuehnegger *In its* Invest. of Perognathus as an Exptl. Organism for Res. in Space Biol. Aug. 1963 p 118–126 (See N63-23530 24-16) OTS: $10.50 ph, $4.19 mf

The sequential approach which will govern the design and investigation of this proposed life-support system is as follows: (1) the determination of operational limitations; (2) the general metabolic requirements of the specimen; (3) the integration of metabolic requirements into system operation; (4) the life-support system schematic; (5) modular breakdown; (6) the specimen module; and (7) the experiment support module. I.v.L.

N63-23543 Carnegie Institution of Washington, D.C.
BIOPHYSICS
E. T. Bolton, R. J. Britten, D. B. Cowie, B. J. Mc Carthy, J. E. Midgley, and R. B. Roberts *In its* Annual Rept. of the Director of the Dept. of Terrest. Magnetism, 1961–1962 Dec. 10, 1962 p 244–290 (See N63-23539 24-01)

Research in biophysics is reported in the following areas: (1) incorporation of RNA bases into the metabolic pool, and the RNA of *E. coli*, (2) RNA composition, (3) kinetic studies of RNA composition, (4) purification of D-RNA, (5) kinetics of labeling of turnip yellow mosaic virus, (6) control mechanisms—RNA vs protein synthesis, and (7) cell-free synthesis. P.V.E.

N63-23563 National Research Council, Washington, D.C.
THE BIOLOGICAL ACTION OF RADIOFREQUENCY ELECTROMAGNETIC FIELDS AND MAGNETIC FIELDS Summary Report
Aug. 1963 7 p 1 ref

Investigations were conducted on the biological action of radiofrequency electromagnetic and magnetic fields in a study concerning the potential contributions to biology which may come from the ability to conduct experimental investigations in space. The impression was that so far as decoupling terrestrial organisms from the normal environment as regards magnetic and radiofrequency fields, no large and no deleterious effects seem likely, but that much higher fields in spacecraft might pose a different problem. C.L.W.

N63-23599 Esso Research and Engineering Co., Linden, N.J.
DETECTING EXTRATERRESTRIAL LIFE
Warren G. Meinschein Repr. from Ind. Res., Sept. 1963 4 p (NASA Contract NASw-508)

The importance of the meteoritic investigations, the methods of detecting extinct living things, and the investigation of carbon compounds in chondrites are discussed. Although rockets make it possible to sample existing bodies outside the earth, meteorites are felt to represent a more extensive sampling of extraterrestrial body or bodies than can be acquired by rockets for a number of years. Investigations have established that some meteorites contain biological-type compounds. Considerable similarity has been found between aromatic hydrocarbons from the Orgueil meteorite and recent marine sediments, suggesting that life existed centuries ago in a meteoritic parent body. R.T.K.

N63-23607 Joint Publications Research Service, Washington, D.C.
BIOLOGICAL AND TECHNICAL ASPECTS OF CYBERNETICS
E. Nicolau and C. Balaceanu Oct. 25, 1963 20 p 12 refs Transl. into ENGLISH from Automatica si Electronica (Bucharest), v. 3, no. 3, May–June 1963 p 100–106 (JPRS-21605; OTS-63-41009) OTS: $0.50

The method of the functions of nets formed by a small number of interconnected elements—paucineuronal nets—is proposed. First, a series of classical data from the literature on the logico-mathematical study of paucineuronal nets is given; an equivalent scheme of neuron function is then presented. It is demonstrated that, starting with the simplified scheme, it is possible to realize paucineuronal learning systems. In addition to simple paucineuronal schemes capable of forming conditioned

reflexes, the principal scheme of a system which realizes the function of self-correlation and, in general, the function of correlation is described. R.T.K.

N63-23609 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
REACTION OF HYDRAZINE AND NITROGEN TETROXIDE IN A LOW-PRESSURE ENVIRONMENT
Robert A. Wasko. Repr. from AIAA Journal, 1963 1 p

A preliminary study was made of the reaction N_2H_4 and N_2O_4 at pressures as low as 10^{-4} torr (mm Hg). A steel vacuum tank served as a vessel wherein stoichiometric quantities of these propellants, separately encapsuled in glass tubing under atmospheric pressure and at room temperature, were broken simultaneously. Results indicate that: (1) an explosive reaction occurs only when a sufficient quantity of propellant was used to produce a vaporized mixture pressure greater than 4 torr; (2) the reaction changed from an explosion to a slower reaction, for the decade of initial ambient pressure from 10^{-1} to 1 torr, as evidenced by a decrease in the magnitude of the explosion pressure and an increase in the reaction delay time; and (3) the N_2O_4 vaporized more quickly than N_2H_4, and the temperature decrease due to vaporization was sufficient to cause freezing of a portion of the N_2H_4. I.v.L.

N63-23616 Union Carbide Research Inst., Tarrytown, N.Y.
THE GENERAL AND COMPARATIVE BIOLOGY OF TERRESTRIAL ORGANISMS UNDER EXPERIMENTAL STRESS CONDITIONS Quarterly Report One
S. M. Siegel Sept. 30, 1963 123 p refs
(NASA Contract NASw-767)
(NASA CR-52082) OTS: $10.10 ph, $3.89 mf

The stress responses of 300 species and varieties of seed plants, 24 species of lower plants and protista, and over 20 species of animals to environmental conditions of a nearly simulated Mars Equatorial Summer and Anaerobic Desert conditions were studied. Seed germination was selected as a means for biological evaluation of atmosphere, temperature, and water availability. Winter rye withstood the environmental stress better than other seed plants, and fungi introduced accidentally as spores, grew well during simulator operation. Hydrogen production from sterilized seeds was observed. Winter rye shows a regular decline in germination as the osmotic pressure of sodium chloride is increased, and the presence of calcium enables rye to germinate without inhibition at the highest osmotic pressures tested. Most invertebrates tested, and the common turtle, were found to survive under variations in air and oxygen pressure. The *Cephalous*, metazoan, withstood centrifugation at 100,000 g. The response of seed germination to partial pressure of oxygen varies with the species and within the species. R.T.K.

N63-23721 Joint Publications Research Service, Washington, D.C.
PROBLEMS OF CYBERNETICS (NO. 9)
Aleksey Andreyevich Lyapunov, ed. Oct. 14, 1963 refs
Transl. into ENGLISH of book "Problemy kibernetiki", Moscow, State Publ. House of Phys.-Math. Lit., 1963 p 1-360
(JPRS-21448; OTS-63-31941) OTS: $7.25

This review of problems in cybernetics includes: (1) the theoretical aspects of cybernetics; (2) transformations determined by finite automata; (3) the classification of the functions of many-valued logic; (4) the synthesis of two-terminal switching circuits; (5) the theory of defining relations for automata; (6) the concept of "useful information;" (7) programing; (8) the game theory; (9) modeling production processes on electronic digital computers; (10) modeling the production process of an automated mill for the furnace-welding of pipes; (11) problems of mathematical linguistics; and (12) "errors" in the reproduction of nucleic acids and their proteins, and the biological significance of these "errors." I.v.L.

N63-23748 Texas U., Austin
RESPONSES OF RHESUS MONKEYS TO PROBABILISTIC SEQUENTIAL DEPENDENCIES
John E. Overall and W. Lynn Brown Repr. from J. Gen. Psychology, v. 69, 1963 p 69-74 refs

First-order stimuli are defined as those which occur most frequently in the population of stimuli from which they are drawn; relationships between consecutive stimulus events are defined as second-order stimulus probabilities. The probability learning of rhesus monkey was investigated to determine whether it is solely a function of first-order stimulus events or whether it is also a function of contingencies between consecutive events. Results indicated that second-order stimulus probabilities significantly influenced the behavior of the subjects. R.T.K.

N63-23751 Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.
CIVIL EFFECTS STUDY CAMDEN-DELAWARE VALLEY AREA (ARMS-II)
R. B. Guillou AEC Div. of Tech. Inform., Nov. 10, 1961 23 p 7 refs
(CEX 61.6.3) OTS: $0.50

An Aerial Radiological Measuring Survey (ARMS) of the Camden-Delaware Valley area was made as part of a nationwide program to measure present environmental levels of gamma radiation. Aerial measurements of ground radio activity in the area were everywhere consistent with what was expected, considering the geology of the area. The south part of the area has a low radioactivity, and the surficial materials are mostly sands and gravels, which are commonly weakly radioactive. The north part of the area is slightly more radioactive, which would be expected from the types of sedimentary, igneous, and metamorphic rocks exposed there. Artificial radionuclides are probably present in only small quantities, because the maximum background gamma radioactivity in many places is less than 200 counts/sec. Author

N63-23780 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.
A MODIFIED LABORATORY TECHNIC FOR PREPARING CHROMOSOMES FROM HUMAN AND ANIMAL PERIPHERAL BLOOD LEUKOCYTES
John W. Foft and Petra A. Romero Sept. 1963 9 p 10 refs
(SAM-TDR-63-44)

A method for obtaining chromosome spreads from human and animal blood is presented in detail. It is based on previously described methods which have been modified to improve the chances of successful culture and to provide a more flexible system for clinical and experimental purposes. Author

N63-23811 Chicago U., Ill.
STUDIES ON HABITUATION OF VESTIBULAR REFLEXES. EFFECT OF CALORIC STIMULATION IN DECORTICATED CATS
Cesar Fernandez and R. S. Schmidt Brooks AFB, Tex. School of Aerospace Medicine, Sept. 1963 23 p refs
(Contract AF 41(609)-1479)
(SAM-TDR-63-61)

Habituation of nystagmus elicited by repetitive caloric stimulation was studied in seven decorticated cats. The histopathologic studies revealed total ablation of neocortex, excepting small remnants in two cases, and extensive damage to basal ganglia and diencephalon. All animals exhibited response decline of nystagmus, demonstrating that neocortex, and probably basal ganglia and diencephalon, are not essential for inducing habituation. There was no conclusive data regarding transfer and long-lasting retention of the response decline. The locus and neurophysiologic basis of the phenomenon are discussed. Author

N63-23812 Albert Einstein Medical Center, Philadelphia, Pa.
THE DISTRIBUTION AND THE CHEMICAL FORMS OF 2-MERCAPTOETHYLGUANIDINE AND BIS(2-GUANIDOETHYL) DISULFIDE GIVEN ORALLY IN PROTECTIVE DOSES TO MICE
George Kollmann, Bernard Shapiro, and Emanuel E. Schwartz
Brooks AFB, Tex., School of Aerospace Medicine, Jan. 1963 10 p refs
(Contract AF 41(657)-300)
(SAM-TDR-62-150)

The distribution and chemical forms of 2-mercaptoethylguanidine (MEG) and bis(2-guanidoethyl) disulfide (GED) were studied in the various tissues of 8- to 10-week-old C57B1 male mice 30 minutes after an oral protective dose of 400 mg/kg of MEG-S^{35} and GED-S^{35}. At 30 minutes after oral administration of MEG or GED, a significant amount of protective agent remained in the gastrointestinal tract. This accounts for some of the differences in $LD_{50/30}$ values for equal doses of protective agent by oral and intreperitoneal routes. MEG was absorbed from the intestines more rapidly than GED, and protective forms appeared in the tissues in higher concentrations after MEG. This explains the better protection provided by oral MEG as compared with oral GED. Author

17 MACHINE ELEMENTS AND PROCESSES

Includes: bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; and materials fabrication, handling, and inspection.

For related information see: 06 Auxiliary Systems.

N63-23002 Rock Island Arsenal Lab., Ill.
PERFORMANCE OF URETHANE VULCANIZATES IN ENVIRONMENTS OF HIGH HUMIDITY
Frank B. Testroet Aug. 30, 1963 36 p 4 refs
(RIA-63-2808) OTS: $1.25

Polyester-urethane elastomeric end items have exhibited severe breakdown after service periods of as little as one to two years. The rubber becomes tar-like within an unreasonably brief period of service and is rendered unfit for further use. Duplication of this rubber failure under laboratory conditions was accomplished by exposing specimens over water at 158° F and at room temperature. Two modes of degradation appear to occur simultaneously and independently of one another; i.e., hydrolysis or chain scission of specimens exposed at 158° F and microorganism attack of the specimen at room temperature accompanied by hydrolysis. A polycarbodiimide and pentachlorophenol demonstrate their ability to retard chain scission and microorganism attack, respectively. Author

N63-23051 Franklin Inst., Philadelphia, Pa. Labs. for Research and Development
SOLUTION OF THE STABILITY PROBLEM FOR 360° SELF-ACTING, GAS-LUBRICATED BEARINGS OF INFINITE LENGTH Interim Report
V. Castelli and H. G. Elrod, Jr. Mar. 1963 160 p 34 refs
(Contract Nonr-2342(00)(FBM))
(I-A 2049-20)

This is an investigation of the stability of self-acting gas-lubricated bearings. Two approaches to the solution are presented, and their results are compared. The particular case of a 360° journal bearing of infinite length is treated, and the changes necessary to use the same theories with other geometries are pointed out. Available experimental results are collected and compared with theory. Author

N63-23069 Aerojet-General Corp., Sacramento, Calif. Solid Rocket Plant
RESEARCH AND DEVELOPMENT IN SUPPORT OF THE POLARIS PROGRAM. TASK V: DEVELOPMENT OF HIGH STRENGTH IMPREGNATED ROVING FOR FILAMENT WINDING [Second Bimonthly Progress Report], June 10-Aug. 9, 1963
Sept. 30, 1963 7 p
(Contract NOw 63-0627c (FMB))
(Rept. 0627-V-2)

This report describes progress in a program conducted to improve uniformity and strength utilization in preimpregnated roving for filament-wound rocket chambers. Author

N63-23099 Oak Ridge National Lab., Tenn.
STUDIES IN CONTACT MICRORADIOGRAPHY
R. W. Mc Clung Oct. 16, 1963 17 p 6 refs
(Contract W-7405-eng-26)
(ORNL-3511)

Recent developments in techniques for low-voltage radiography have found application for the examination and evaluation of minute details in small or thin specimens. Utilization of X-ray tubes and helium chambers with thin windows for maximum transmission of soft X-rays and bare film with dark-room exposure techniques have allowed very high contrast radiographs to be produced on low-contrast materials. These conditions, coupled with very high resolution photographic emulsion detectors, have resulted in the observation of detail approximately 1μ in size. Useful examination of the plates and subsequent reproductions have been made at magnifications as high as 500X. This contact system offers the advantage of evaluation of a relatively large area, as compared to the restricted field of observation of projection microradiography. Included among the subjects have been graphite-coated UC_2 particles, graphite, beryllium, paper, and other organic specimens. Author

N63-23170 Naval Research Lab., Washington, D.C.
STUDIES OF PORTABLE AIR-OPERATED AEROSOL GENERATORS
W. H. Echols and J. A. Young July 26, 1963 18 p
(NRL-5929) OTS: $0.50

These generators are used to produce polydisperse liquid aerosols. At a given pressure and the consequent flow rate, the polydispersion produced by each generator is reproducible both in terms of particle-size distribution and aerosol mass concentration, but each generator model differs significantly from the others in total aerosol output as well as particle-size distribution at the same operating pressure. The only requirements for operation of the aerosol generators are an adequate, filtered, and well-regulated compressed air supply

and the liquid to be disseminated. When DOP (di(2-ethylhexyl)-phthalate) is used as the liquid, the dispersed phase of the aerosol system has a light-scattering geometric mean diameter of the magnitude of one-half micron. Author

N63-23559 Goodyear Aerospace Corp., Akron, Ohio
STUDY OF THE EFFECTS OF MECHANICAL DAMAGE ON THE PERFORMANCE OF FILAMENT-WOUND MOTOR CASES Progress Report No. 3, 1 Aug.-30 Sept. 1963
R. A. Burkley, T. J. Boller, and I. R. Butcher Oct. 20, 1963 24 p 3 refs
(Contract NOw-63-0449-c (FBM))
(GER-11154B)

This report discusses the conclusion of the fabrication, machine flawing, and testing of six-in.-diam. filament-wound bottles. The objectives of the study program are to study the effects of surface flaws on the performance of Polaris motor cases, to compare the effect of winding sequence on the ability to resist failure from surface flaws, and to determine the reliability of various repair techniques. Author

N63-23713 SKF Industries, Inc., King of Prussia, Pa.
INFLUENCE OF LUBRICATION ON ENDURANCE OF ROLLING CONTACTS Progress Rgport No. 6, Dec. 22, 1962-Mar. 22, 1963
W. Schmidt, J. Mc Cool, R.Valori, T. Tallian, E. F. Brady et al [1963] 47 p refs
(Contract NOw-61-0716-C)
(AL63T016)

Additonal radioactive wear tests at 150 lb load were run in a rolling four-ball testing machine. The rolling speed above which the wear is negligible, according to the radiotracer results, corresponds to the speed at which previous electrical conductivity results had indicated essentially complete hydrodynamic separation of the surfaces. Preliminary endurance tests on 1/2-in. steel balls were run in a rolling 4-ball (Barwell) testing machine under a series of loads. The purpose of these tests was to determine the load range within which the cubic load-life relationship (as found for complete ball bearings) is valid. Test results indicate that for 52100 steel balls of 62 to 64 R_c hardness, the theoretical load-life relationship is valid up to a spindle load of 182 lb on a 4-ball set of 1/2-in. balls having 40° contact angle. Author

N63-23774 Naval Research Lab., Washington, D.C.
DYNAMIC SURFACE PHENOMENA IN THE SPONTANEOUS SPREADING OF OILS ON SOLIDS
W. D. Bascom, R. L. Cottington, and C. R. Singleterry July 30, 1963 21 p 16 refs
(NRL-5963)

A detailed study has been made by interference microscopy and ellipsometry of the spontaneous spreading of a variety of nonpolar liquids on smooth, clean metal surfaces. Spreading is generally characterized by the advance from the bulk liquid of a primary film having a thickness of much less than 1000A; this primary film is usually followed by a considerably thicker secondary film. The movement of the secondary film is the result of a surface tension gradient across the transition zone between the primary and secondary films. This gradient is produced by the unequal evaporative depletion from these two regions of a volatile contaminant having a lower surface tension. If the volatile contaminant has a higher surface tension than the main component, the direction of this surface tension gradient may be reversed so that the liquid recedes rather than spreads. Removal of the relatively more volatile constituents from the test liquid eliminates the spreading of the secondary film but not the spreading of the primary film. Author

N63-23808 Ohio U., Athens Coll. of Engineering and Tech.
LEAK DETECTION TECHNIQUES IMPROVEMENT STUDY FOR SPACE VEHICLES Formal Report No. 2 [for Period Ending May 31, 1963]
June 1963 298 p refs
(NASA Contract NAS8-2563)
(NASA CR-52323) OTS: $18.50 ph, $9.14 mf

An intensive survey of the literature of the past 30 years has been made; an up-to-date bibliography and selected abstracts are included. The salient virtues and shortcomings of the hot anode halogen gun are covered in some detail. Tests on two thermistor bridges are described with respect to applicability and limitations. A miniaturized mass-spectrometer, utilizing the time-of-flight principle, and the Vacion pump may offer the most sensitive method of detecting leaks, without undue sacrifice of portability. The detection of leaks by acoustics is described with test results included for the Delcon Ultrasonic Translator. A very interesting corollary which seems to offer considerable promise is the sonic injection technique by which sound energy is injected into the system and emerges with the leaking gas. The leak is detected and identified by frequency shift and correlation methods. From the systems concept standpoint, microwave information-gathering techniques seem most attractive. Using high-frequency components in the K or X band, weight and size limitations can be met, and information can be obtained in both a space or earth environment. Author

18 MATERIALS, METALLIC

Includes: cermets; mechanical and physical properties of alloys and metals; and metallurgy.

For related information see: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Non-metallic; 33 Stresses and Loads; and 34 Structural Design.

N63-23003 Pratt and Whitney Aircraft, East Hartford, Conn.
RESEARCH AND DEVELOPMENT OF TITANIUM ROCKET MOTOR CASE Eleventh Quarterly Report [Jan. 1-Mar. 31, 1963]
H. A. Hauser and W. E. Helfrich Apr. 30, 1963 82 p
(Contract DA-19-020-ORD-5230)
(WAL TR-766.2/1-10) PWA-2213)

The results of work performed on the research and development of a high-strength lightweight titanium-alloy rocket case are reported. These include: (1) results of notched (K_t = 8) sustained load bump-up tests conducted on flow-turned material with hydrogen contents of 70 and 200 ppm, (2) tensile data (70° F) for Ti-6Al-6V-2Sn alloy TIG welds, (3) results of investigation of various stress-relieving techniques for B-120 VCA titanium alloy weldments, (4) aging response tensile data (70° F) for center punchouts from full-scale rear-dome dogbone preforms, (5) evaluation, including mechanical property testing, of full-scale rear-dome and flow-turned center section burst-test assemblies after hydrostatic testing to destruction, and (6) tensile test data (70° F) for Ti-15 Mo-alloy sheet stock in the solution treated and aged conditions. Author

N63-23014 National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
STRESS CORROSION OF HIGH-STRENGTH ALUMINUM ALLOYS

T. S. Humphries June 24, 1963 22 p 2 refs
(NASA TM X-50924; MTP-P&VE-M-63-8) OTS: $2.60 ph, $0.86 mf

The stress-corrosion properties of some of the most commonly used high-strength aluminum alloys—2014, 2024, 2219, 7075, 7178, and 7079—are presented. The effectiveness of a few protective finishes in combating stress corrosion is also presented. Alternate immersion in 3-1/2-percent salt solution and exposure to the atmosphere constituted the test media. It was found that all of the high-strength aluminum alloys tested were highly susceptible to stress-corrosion cracking in the short transverse direction except 7075-T73 and 2219-T87. Neither chemical conversion nor anodic coatings were effective in combating stress corrosion; however, either of these coatings plus zinc chromate primer afforded considerable protection. Author

N63-23028 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EVALUATION OF WELDED 2219-T87 ALUMINUM ALLOY
Richard A. Davis Dec. 19, 1962 35 p 2 refs
(NASA TM X-50837; MTP-P&VE-M-62-16) OTS: $3.60 ph, $1.25 mf

Metal arc, inert gas shielded (MIG) welds and tungsten arc, inert gas shielded (TIG) welds were evaluated in plate thicknesses of 1/4, 1/2, 3/4, and 1 inch for aluminum alloy 2219-T87. Studies were conducted to determine the extent of weld heat affected zone into the base metal. A value of 1 3/8 inches from the centerline of the weld is given as a maximum extent of heat affected zone, if proper joint design and welding process are employed. TIG welds were more consistent in strength, slightly higher in ultimate strength values, and exhibited better weld quality than MIG welds. Author

N63-23037 Cook Electric Co., Morton Grove, Ill.
IMPROVEMENT OF NICKEL-CADMIUM BATTERIES Monthly Technical Progress Report No. 28, July 20-Aug. 20, 1963
[1963] 24 p
(NASA Contract NAS5-1048)
(NASA CR-51597) OTS: $2.60 ph, $0.92 mf

Tabular data on the results of life-cycle testing and failure analysis of nickel–cadmium batteries is presented. P.V.E.

N63-23107 Atomic Energy Commission, Bombay (India)
DIFFUSION OF CHROMIUM IN ALUMINUM
R. P. Agerwala, S. P. Murarka and M. S. Anand 1963 14 p
(AEET-CD-15)

The diffusion coefficient of chromium in aluminum has been determined over a temperature range of 250° to 605° C using radioactive tracer and residual activity technique. The diffusion coefficient (in units of cm^2/sec) is given by

$$D_{Cr/Al} = 3.01 \times 10^{-7} \exp(-15{,}400/RT)$$

The frequency factor and activation energy are quite small as expected for low solid solubility of chromium in aluminum. In the present case, diffusion is explained to occur through dislocation short circuiting paths as observed for the diffusion of iron, nickel and cobalt in aluminum. Author

N63-23111 Battelle Memorial Inst., Columbus, Ohio
THE STATUS AND PROPERTIES OF TITANIUM ALLOYS FOR THICK PLATE
G. E. Faulkner, W. J. Lewis, and D. C. Martin June 14, 1963 51 p 14 refs
(Contract AF 33(616)-7747)
(DMIC-185)

Thick plate of titanium alloys is of current defense interest for possible use in submarines, armored vehicles, and big boosters and other pressure vessels. This interest is based on the well-established strength-weight properties of titanium alloys, their good corrosion resistance, and known problems in applying steels in these structures. Although data are scarce, a review of the available information permits some conclusions about the present status of titanium alloys in thick-plate form. Author

N63-23112 Battelle Memorial Inst., Columbus, Ohio
STUDY OF LOCAL ORDER AND SOLID-SOLUTION STRENGTHENING IN COLUMBIUM ALLOYS [Interim Report, May 1, 1962-Apr. 30, 1963]
P. S. Rudman Wright-Patterson AFB, Ohio. AF Mater. Lab., May 1963 31 p 14 refs
(Contract AF 33(657)-8844)
(ASD-TDR-63-567)

The results of experimental X-ray diffuse scattering for Nb-Ti alloys are presented, showing that this system apparently exhibits relatively little order. The theory of diffuse scattering is re-derived, yielding an order-fluctuation-dependent small-angle scattering. The question of the range of fluctuations is treated. Author

N63-23139 Joint Publications Research Service, Washington, D.C.
USSR INDUSTRIAL DEVELOPMENT: SOVIET METALWORKING EQUIPMENT, NO. 74
M. A. Anuchin et al Oct. 15, 1963 11 p 2 refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Mashinostro. (Moscow), no. 3, 1963 p 194–199
(JPRS-21459; OTS-63-31943) OTS: $0.50

The techniques being used in the U.S.S.R. for the stamping of sheet metals by explosion are reviewed. Recommendations are presented for determining the strain energy of distortion of the articles and the weight of the charge which can be used under industrial conditions. The most extensively used technique consists of blanking by an underwater explosion shock wave, although explosive stamping is also performed through solid media, free-flowing powder, and plastic substances. The economics of explosive stamping show that this technique is justified only in specific instances of making large articles or articles of hard-to-stamp materials, such as titanium alloys and steel superalloys in individual or small-series production. M.P.G.

N63-23165 Battelle Memorial Inst., Columbus, Ohio
FURTHER INVESTIGATION OF NOTCH SENSITIVITY OF REFRACTORY METALS Third Quarterly Progress Report
A. G. Imgram, A. Gilbert, C. W. Marschall, E. S. Bartlett, G. T. Hahn et al Oct. 15, 1963 27 p
(Contract AF 33(657)-10363)

Progress is reported on the study of the effect of a silicide coating on the tensile and notch tensile transition characteristics and fracture toughness of TZM (titanium–zirconium–molybdenum) and D-43 (columbium) alloys, along with efforts toward understanding the fundamentals of crack propagation and studies of the effect of interstitial oxygen content on the impact transition of wrought tantalum and columbium. C.L.W.

N63-23177 Brookhaven National Lab., Upton, N.Y.
HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW, VOLUME I, NO. 4
O. E. Dwyer, ed. Aug. 1963 42 p
(BNL 825(PR-4) OTS: $0.75

Reviews of progress reports of research and development activities in high-temperature liquid-metal technology are presented. The reviews are categorized as follows: physical properties and thermodynamics; fluid dynamics; heat transfer; material development and corrosion; instrumentation; component development; system studies; chemical analysis and chemistry; and fabrication techniques. M.P.G.

N63-23289 McGill U., Montreal (Canada) Eaton Electronics Research Lab.
TRANSVERSE MAGNETORESISTANCE OF HIGH-STRENGTH COPPER ALLOYS
Richard Stevenson and Richard Bolton *In its* Annual Rept. to ONR [Res. in the Area of High Field Magnet System] Aug. 1963 5 p Repr. from Can. J. Phys., v. 41, 1963 p 985-986 (See N63-23286 24-09)
(Supported by ONR and DRB)

Two copper alloys have been developed, chromium-copper (0.3% Cr) and zirconium-copper (0.12% Zr), which have room-temperature conductivities comparable with that of copper and tensile strengths greater than 60,000 psi. They are of interest in the design of high-performance electrical apparatus which must be operated at low temperatures. Measurements on the electrical properties of the various samples are reported as follows: (1) resistance ratios at 4.2° K, (2) the ratio of the resistance at 77° K minus that at 4.2° K to the resistance at 273° K minus that at 4.2° K, and (3) magnetoresistance data at 77° K and 4.2° K as a function of the external field and the resistance ratio. At a high magnetic field, copper was found to have the lowest magnetoresistance, but the results suggest that at even higher fields, the zirconium–copper alloy will have the lower magnetoresistance. R.T.K.

N63-23348 Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
PILOT PRODUCTION AND EVALUATION OF TANTALUM ALLOY SHEET Quarterly Report No. 5, May 15-Aug. 15, 1963
R. L. Ammon and R. T. Begley Oct. 15, 1963 27 p 8 refs
(Contract N600(19)-59762)
(WANL-PR-M-006)

The evaluation of T-222 (Ta-9.6W-2.4Hf-0.01C) sheet was continued. Duplicate tensile tests of recrystallized and stress-relieved sheet were conducted in the temperature range 1800° to 3500° F. Stress rupture properties at 2400° and 3000° F were established. Aging studies to determine optimum thermal and mechanical treatments for improved high-temperature tensile strength were initiated. Author

N63-23351 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
LITHIUM, FIELDS OF KNOWN AND POSSIBLE APPLICATION
Boris Iosifovich Kogan Oct. 1, 1963 155 p refs Transl. into ENGLISH by JPRS from Publ. by All-Union Inst. of Sci. and Tech. Inform. (Moscow), 1960

A list of already developed and possible spheres of application of lithium, its alloys, and compounds is presented. Properties of metallic lithium and a list of assorted lithium products currently manufactured in foreign countries (excluding the U.S.S.R.) on an industrial or laboratory scale are also presented. P.V.E.

N63-23354 Joint Publications Research Service, Washington, D.C.
USSR INDUSTRIAL DEVELOPMENT: SOVIET FERROUS METALLURGY NO. -153
S. Ya. Ravicher Oct. 22, 1963 8 p Transl. into ENGLISH from Vystavka Dostizh. Narodnogo Khoz. (USSR), no. 8, Aug. 1963 p9-11
(JPRS-21546; OTS-63-31983) OTS: $1.25

Exhibits shown at the Exposition of Achievements of the National Economy are discussed. These exhibits include: (1) products made from hard carbide-chromium alloys; (2) principle elements of powder-metallurgy technology covering the production of raw materials for powder metallurgy, pressing of the mixture in special molds using hydraulic and mechanical presses, sintering of the product in a protective atmosphere where it receives specified physical and mechanical properties, impregnation of the finished product with oil to obtain self-lubricating properties, and final processing of the product, which includes finishing operations, gauging, compressing, and heat treatment; and (3) automatic presses of the series developed by ENIKmash. I.v.L.

N63-23390 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INCREASING THE MECHANICAL PROPERTIES OF CASTINGS BY THERMAL TREATMENT OF THE METAL IN LIQUID STATE
A. G. Spasskiy and B. A. Fomin July 29, 1963 11 p 6 refs Transl. into ENGLISH from "Issledovaniye Splavov Tsvetnykh Metallov," Moscow, Izd. AN SSSR, no. 3, 1962 p 143-148
(FTD-TT-63-714/1+2)

The mechanical properties of alloys, subjected to thermal treatment in the liquid state, were investigated. Experiments were conducted in the following manner: The alloy was divided into two parts, one was melted without overheating and the other was overheated. Both parts were poured together into one bucket, stirred, and the melt poured into a cast mold. In all Al-9 alloy species tested, without exception the ultimate strength and the elongation per unit length were considerably increased. I.v.L.

N63-23406 General Electric Co., Cincinnati, Ohio Nuclear Materials and Propulsion Operation
HIGH-TEMPERATURE MATERIALS PROGRAM Progress Report No. 27, Part A [June 15-Aug. 15, 1963]
Sept. 30, 1963 50 p refs
(Contract AT(40-1)-2847)
(GEMP-27A) OTS: $1.25

Progress reported includes the following: (1) Stress-rupture and creep properties of W-25 wt % Re flat specimens irradiated at reactor ambient temperature to a dosage of approximately 8×10^{18}nvt($E_n \geq 1$ Mev) have been measured at 1100° C. There was a consistent lowering of the creep rate of the irradiated specimens, although the rupture life of the irradiated specimens was not significantly changed when compared to the control specimens. (2) Rhenium irradiated to approximately 8×10^{18}nvt($E_n \geq 1$ Mev) and tested at 1100° C appeared to have a lower creep rate and a slightly longer rupture life than unirradiated specimens tested at the same temperature. (3) Tungsten specimens irradiated at reactor ambient temperatures to a dosage of about 3.7×10^{18}nvt ($E_n \geq 1$ Mev) and tested at 1100° C show a slight increase in rupture life. The minimum creep rate was not significantly changed when compared to a control specimen. (4) Irradiated ($\sim 5 \times 10^{19}$nvt, $E_n \geq 1$ Mev) A-286 specimens containing 0.00085% boron show the greatest reduction in rupture life when compared to control specimens. (5) A-286 specimens irradiated at 690° C to a dosage of approximately 4×10^{19}nvt($E_n \geq 1$ Mev), and tested at 650° C, show a significant increase in fatigue life when compared to control specimens. I.v.L.

N63-23407 Aeronutronic, Newport Beach, Calif.
INVESTIGATION OF MECHANISMS FOR OXIDATION PROTECTION AND FAILURE OF INTERMETALLIC COATINGS FOR REFRACTORY METALS. PART I. MOLYBDENUM DISILICIDE
R. W. Bartlett et al Wright-Patterson AFB, Ohio, Air Force Materials Lab., June 1963 76 p 13 refs
(Contract AF 33(657)-9170)
(ASD-TDR-63-753; Pt. I)

A thermogravimetric and electron microscopic study of the oxidation of molybdenum silicides, particularly $MoSi_2$, was made using powders and hot pressed samples. Temperatures below 1450° C and oxygen pressures from 0.01 to 1 atm were employed. Oxidation of $MoSi_2$ is retarded by a continuous adherent oxide layer which consists of 1μ to 20μ islands, containing MoO_3 and cristobalite, included within an amorphous matrix film. Below 600° C the islands are absent, but nonadherent amorphous specks of SiO_2 and MoO_3 crystals form on the amorphous film. The SiO_2 specks appear as clusters of ~200 Å spherical particles growing on randomly oriented nucleation sites. This growth is not self-limiting and constitutes Fitzers' silicide "pest." Author

N63-23470 Aeroprojects, Inc., West Chester, Pa.
ULTRASONIC WELDING OF SELECTED REFRACTORY METALS AND ALLOYS Final Report
June 1963 102 p 35 refs
(Contract NOw-61-0410-c)
(Res. Rept. 63-54)

Investigations with thin gages of molybdenum–0.5% titanium alloy, niobium–10% titanium–10% molybdenum alloy, and tungsten, showed that these materials are susceptible to ultrasonic welding, and that the strength decay of such ultrasonic welds at 2000° F is not appreciably greater than that of the parent sheet material. Weld cracking tendencies in some instances were attributed primarily to material contamination, and in other instances to nonuniform material quality. It was postulated that improved weld quality can be obtained by strict control of material quality and by the use of programed ultrasonic power and clamping force. Author

N63-23494 National Lead Co., Niagara Falls, N.Y. Titanium Alloy Mfg. Div.
THERMOELECTRIC MATERIALS Final Report
Merton H. Brooks, ed. Jan. 31, 1963 85 p
(Contract NObs 78326)

Among electronic semiconductors were the following n-type examples. Titanium dioxide plus 2.0$^m/_o$ Nb_2O_5 exhibited a Seebeck coefficient of −400μv/° C and resistivity of 0.1 ohm-cm over the entire temperature range of test. Barium titanate plus 0.5$^m/_o$ Nb_2O_5 had a Seebeck coefficient of −1700μv/° C at 750° C increasing in magnitude to −3000μv/° C at 1225° C; the resistivity of this composition is unknown but is certainly greater than 5 ohm-cm. No *p*-type electronic semiconductor with consistent carrier type over the entire temperature range of test was developed. Positive Seebeck coefficients of considerable magnitude were developed in ionic conductors: ZrO_2-7$^m/_o$ Y_2O_3 solid solution plus 10$^m/_o$ Nb_2O_5 exhibited a Seebeck coefficient of +1000μv/° C at 800° C rising to +1600μv/° C at 1100° C. The electrical resistivity of this composition was also greater than 5 ohm-cm. In general, most oxide semiconductors examined were found to be ionic conductors: Li_2TiO_3 was the singular example of such a material. Author

N63-23509 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
LATTICE VIBRATION DISTRIBUTION AND SPECIFIC HEAT OF BI-METALLIC REGULAR LATTICE
Y. Shibuya, Y. Fukuda, and T. Fukuroi Oct. 9, 1963 8 p refs Transl. into ENGLISH from Busseiron Kenkyu (Japan) v. 41, 1951, p 17–20
(RSIC-81)

The vibration frequency distribution and the lattice specific heat in beta-brass are investigated. Results indicate that: (1) when the effects of the 2nd neighbors are large (i.e., the force is of relatively long range and the isotropy of the substance is quite good) the relationship in magnitude of specific heats for S = 1 and S = 0 is inverted between high and low temperatures; this is independent of the atomic weights involved in the alloy; (2) when the effects of the 2nd neighbors are small, this inversion occurs only when the atomic weights of the components of the alloys are similar. The phenomena mentioned in (1) and (2) are mainly due to the fact that the peak on the low-frequency side of the frequency distribution function is independent of C for S = 0, but the peak shifts to the right for S ± 0. I.v.L.

N63-23517 Horizons Inc., Cleveland, Ohio
REINFORCEMENT OF NICKEL CHROMIUM ALLOYS WITH SAPPHIRE WHISKERS Final Report Sept. 28, 1962–Sept. 27, 1963
Robert H. Kelsey Oct. 25, 1963 57 p refs
(Contract NOw 63-0138-c)

It has been found that a strong bond between alpha-alumina wool and iron may be formed by the addition of oxygen to the metal-fibril system in the form of naturally occurring oxides of iron. Excess oxygen may be removed from metal-alumina wool composites by the addition of aluminum metal. Failure to remove excess oxygen results in degradation of the bond upon continued heating. The development of metal oxides on fiber surfaces and on sapphire plaques, followed by reduction *in situ* has not been found to result in the wetting of sapphire by the subject metals. Evidences of wetting of alumina fibers with iron has been seen when small amounts of iron oxide have been reacted with the fiber surfaces. In amounts in the order of 0.5$^w/_o$ on the fibers, wetting was observed; larger amounts inhibited wetting. Author

N63-23519 Atomics International, Canoga Park, Calif.
PREPARATION OF URANIUM METAL BY CARBON REDUCTION
W. G. Smiley Oct. 30, 1963 17 p 12 refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8507) OTS: $0.50

Pure uranium metal has been prepared by heating oxide–carbon mixtures in a UO_2 crucible in vacuum. Uranium oxycarbide was formed initially; temperatures from 1790° to 1920° C were used to decompose it. Carbon content of the product ranged from 0.05 down to 0.01 wt %. Evaporation losses were observed, but could be reduced to a reasonable level in large-scale production. Author

N63-23584 Materials Research Lab., Inc., Richton Park, Ill.
THE USE OF STRAIN SOFTENING TO IMPROVE THE PROPERTIES OF REFRACTORY METALS Quarterly Progress Report No. 5, June 1, 1963-Aug. 31, 1963
S. Mostovoy and E. J. Ripling [1963] 15 p
(Contract NOw-62-0725-C)

The molybdenum-0.5 Ti alloy was flexed at room temperature with the largest available rolls. It was found that two passes lowered the transition temperature by 60° F. Measuring flexing strains by use of photogrid techniques, and by measuring the radius of curvature of the bent plate, indicate that the large rolls produce almost twice as much

surface strain as the medium sized ones. In flexing molybdenum-0.5 Ti alloy, the NDT (normal delay time) temperature was suppressed with only modest changes in the "knee" of the ductility-testing temperature curve. In the TZM, on the other hand, the NDT was essentially unchanged by flexing, while the knee was lowered approximately 100° F.
Author

N63-23587 Manlabs, Inc., Cambridge, Mass.
THERMOMECHANICAL TREATMENTS APPLIED TO ULTRA-HIGH-STRENGTH BAINITES Third Progress Report
D. Kalish and S. A. Kulin Sept. 15, 1963 40 p ref
(Contract N600 (19)-59811)

Results reported in the study of thermomechanical treatments applied to ultrahigh-strength bainites included: (1) the mechanical properties of steel alloy H11 in the martensitic or bainitic condition are strongly affected by refrigeration in liquid nitrogen when tempered at temperatures below 1000° F; (2) the H11 bainite formed at 550° F exhibits a large secondary strengthening when tempered between 1000 and 1100° F; (3) bainite tempered at 1100° F has a yield strength of approximately 235,000 psi as compared to approximately 212,000 for martensite at the same temperature; and (4) austenite deformation in H11 results in considerable strengthening of the subsequently formed bainite, and liquid-nitrogen refrigeration is then found to have a large effect for tempering temperatures up to 900° F.
P.V.E.

N63-23591 Sheffield U. (Gt. Brit.)
THE MAGNETIC PROPERTIES OF THE HEUSLER ALLOYS Final Technical Report, Aug. 1, 1962-July 31, 1963
[1963] 78 p refs
(Contract DA-91-591-EUC-2645)

The report gives the results of magnetic and crystallographic investigations on the body-centered cubic Heusler alloys of the type Cu_2MnX. The alloys Cu_2MnAl, Cu_2MnSn, and Cu_2MnIn were prepared by melting and quenching from the high temperature bcc phase at 650° C, 625° C, and 535° C, respectively, followed by annealing for some days. Investigations on Cu_2MnSb are discussed in detail. The alloys Cu_2MnBi and CuMnGe previously reported as Heusler phase are found to be polyphase. Au_2MnAl with a Heusler structure was prepared by slowly cooling from the melt, giving a magneton number of 3.02 $2a_o$ = 6.36, and a Curie temperature of 200° K. Au_2MnSn was found to be polyphase. The preliminary results of measurements of Ni_2MnSb, Ni_2MnIn, Ni_2MnSn, and Co_2MnSn are also given.
Author

N63-23608 Joint Publications Research Service, Washington, D.C.
DEPENDENCE OF THE ANISOTROPY CONSTANT OF NICKEL TO TEMPERATURE AND SATURATION MAGNETIZATION
I. M. Puzey Oct. 31, 1963 8 p 13 refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. Akad. Nauk SSSR, Ural'. Filial (Sverdlovsk), v. 15, no. 1, 1963 p 29-32

A comprehensive investigation was conducted on the temperature dependence of the anisotropy constant of nickel near the Curie temperature and at low temperature. An anisotropy constant-saturation magnetization curve was plotted. In the 20° to 150° K region, the anisotropy constant varies as a 70th power of saturation magnetization; in the 150° to 440°, as a 20th power; and close to the Curie temperature, as a first-degree function.
Author

N63-23630 New England Materials Lab., Inc., Medford, Mass.
DISPERSION STRENGTHENED NICKEL-BASE ALLOYS Progress Report No. 3, July 1-Aug. 30, 1963
A. S. Bufferd, R. C. Nelson and N. J. Grant Oct. 17, 1963 8 p
(Contract N600 (19)-59891)

A group of Nichrome-thoria alloys prepared by the thermal decomposition of thorium nitrate onto alloy powder indicated improved room-temperature and equivalent high-temperature tensile properties relative to the base composition. However, in the case of a modified Udimet 500 composition, the thoria-containing alloy showed lower properties than the base composition. In order to increase the amount of stored energy of deformation in the thoria-containing alloys, two alloys indicating a good degree of dispersion, and moderate room-temperature ductility, were cold swaged 81 percent in reduction of area. These swaged alloys are being evaluated.
Author

N63-23663 Air Force Systems Command Wright-Patterson AFB, Ohio
THE USE OF INFRARED ABSORPTION SPECTROSCOPY IN RESEARCH ON HAFNIA AND ZIRCONIA Technical Report [Jan.– June 1963]
William L. Baun and Neil T. Mc Devitt Sept. 1963 18 p refs
(ASD-TDR-63-789)

Infrared spectra are shown for monoclinic ZrO_2 and HfO_2, and cubic stabilized ZrO_2 and HfO_2. Nine to ten bands in the region 800 to 200 cm^{-1} are reported for the monoclinic modification of each, while the stabilized cubic phases show only one broad band over the same frequency range. Both cubic and monoclinic ZrO_2 spectra are qualitatively similar to corresponding phases in HfO_2, but small differences in band position and shape make identification and separation possible in the monoclinic phase of these compounds. The spectrum of tetragonal ZrO_2 (CeO_2 stabilized) is identical to spectra obtained from cubic ZrO_2 samples. The strong dependence of the infrared spectrum on structure and lattice impurities is shown in the spectrum of a monoclinic specimen prepared by heating a low-temperature stabilized sample at 800° C.
Author

N63-23665 Universal-Cyclops Steel Corp., Bridgeville, Penn. Refractomet Div.
WELDING OF REFRACTORY METALS Interim Report No. 4, July 1-Sept. 30, 1963
F. D. Seaman and D. J. Seman Oct. 1963 25 p
(Contract NOw 63-0043-c)

The weld parameters—speed, amperage, and electrode configuration—are reviewed, and the effects of these parameters on the bend ductility of TZM are presented. The effects of InFab atmosphere variations on bend ductility of TZM, B-66, 90Ta-10W, and W are given as preliminary data. The effects of welding these materials under varying degrees of restraint (patch-test) are shown.
Author

N63-23716 Army Missile Command Huntsville, Ala.
QUANTITATIVE SPECTROGRAPHIC DETERMINATION OF ELEMENTS IN SOLUTION
Yasumitsu Uzumasa, Seiichiro Hikime and Hotoshi Yoshida Oct. 9, 1963 12 p refs Transl. into ENGLISH by JPRS from BUNSEKI Kagaku (Japan) v. 5, 1956 p 327-239
(RSIC-78)

A simple procedure has been studied for the simultaneous spectrographic determination of several elements in a solution. An improved atomizer was used in the spark analysis, and one cadmium line was utilized as an internal standard line. The analyses of Al, Fe, Mg, Ca, B, Mn, Na, and K were carried out. Na and K could not be detected below the concentration of 1 g/l; whereas in the case of Mn, the working curve was found to be almost linear in the range of concentrations from

5 mg to 1/gl, in which range the slope was too flat to be used for its estimation. The results of estimation of Al, Fe, Mg, and Ca were excellent, but the results for B in the analysis of the synthesized samples was not so satisfactory. Author

N63-23718 Army Missile Comand Huntsville, Ala.
ORDER AND DISORDER IN BI-METALLIC ALLOYS AND LATTICE VIBRATIONS
T. Oguchi and K. Hiroike Oct. 9, 1963 15 p refs Transl. into ENGLISH by JPRS from Busseiron Kenkyu (Japan) v. 33, 1950 p 37–46
(RSIC-80)

In a bimetallic alloy forming a regular lattice, lattice vibration changes with the order of regularity. A theory of a regular lattice is obtained that takes into account lattice vibrations. Montroll's method based on the Born–Kármán model is used to include lattice vibration in Bragg–Williams' theory of a regular lattice. R.T.K.

N63-23738 Air Force Systems Command Wright-Patterson AFB, Ohio Foreign Tech. Div.
NEW THERMODIFFUSION DATA ON THE CHROMIUM-MOLYBDENUM SYSTEM
D. A. Prokoshkin and O. I. Sidunova May 12, 1963 9 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Mashinostr. (Moscow), no. 5, 1960 p 101–105
(FTD-TT-63-266/1+2)

In the diffusion of chromium into molybdenum at 1,400° C in a vacuum furnace phase recrystallization has been discovered through metallographic analysis. This indicates that in the Cr–Mo system in the solid state there exists an area, previously not discovered, with a special structure and properties. The presence of this area is confirmed by other methods of analysis such as etching and X-ray investigation. Thus, it is concluded that Cr and Mo in the solid state do not form a continuous series of solid solutions. P.V.E.

N63-23769 Air Force Systems Command, Wright-Patterson AFB, Ohio
THERMODYNAMIC CHARACTERISTICS OF LIQUID METAL SOLUTIONS II. BI-IN SYSTEMS
Janusz Terpilowski Dec. 3, 1962 12 p Transl. into ENGLISH from Arch. Hutnictwa (Warsaw), v. 3, no. 3, 1958 p 227–237
(FTD-TT-62-1513/1+2)

The thermodynamic characteristics of liquid Bi-In alloys of the reverse type: $In_{liq}|(0.6\ LiBr + 0.4\ KBr) + 0.1\ InBr|Bi_xIn_{1-x}$/liquid alloy, were investigated. Results indicate that: (1) The EMF-measuring method can be used for studying the thermodynamic qualities of certain binary and probably ternary systems containing indium as a less noble metal, provided that a melted mixture of LiBr and KBr of eutectic composition, with small InBr addition, is used for the preparation of the electrolyte. (2) The liquid Bi-In system characterizes a negative deviation from Raoult's law, decreasing with the rise in temperature. I.v.L.

N63-23781 Aerospace Corp., El Segundo, Calif.
PREPARATION AND PROPERTIES OF ARC-CAST TIC-C ALLOYS
D. H. Leeds, E. G. Kendall, and J. F. Ward (Materials, Sci. Lab.) Sept. 23, 1963 60 p 18 refs
(Contract AF 04(695)-269)
(SSD-TDR-63-216; TDR-269(4240-10)-2)

Preliminary results of an investigation into the properties of titanium carbon alloys are described. Compositions ranging from 18 to 30 w/o carbon were synthesized and fabricated by arc-melting and gravity casting techniques. Microstructures, hardness, modulus of rupture, and compressive strength values are presented. Existence of a hyperstoichiometric eutectic is confirmed, and established in the vicinity of 26 w/o carbon. Improvement in thermal-shock and room-temperature brittleness behavior is obtained from the existence of free graphite platelets throughout the hypereutectic specimens. Results of sonic air-plasma arc-tunnel tests at heat fluxes of 100, 300, and 1600 BTU/ft^2-sec are discussed. Author

N63-23790 North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
DETERMINATION OF MECHANICAL AND THERMOPHYSICAL PROPERTIES OF COATED REFRACTORY AND SUPER-ALLOY THIN SHEET Third Progress Report, Jan. 1–Mar. 1, 1963
C. H. Savage and D. C. Root Apr. 15, 1963 40 p
(Contract AF 33(657)-9416)
(SID 62-1219-3)

The development of test procedures and equipment was continued to evaluate the properties of coated and bare foils of D-36, B-66, and TZM refractory alloys, and of bare foils of Hastelloy X and Rene' 41. The fabrication of the furnace for elevated-temperature testing of foils either in air or vacuum up to 2700° F was completed. The evaluation of the furnace performance and calibration of the temperature- and strain-sensing systems are almost completed. Tensile tests in air at temperatures below 1900° F, and creep and tension–tension fatigue tests on Hastelloy X, have been completed. Author

N63-23813 Douglas Aircraft Co., Ind. Santa Monica, Calif.
FURTHER CONSIDERATIONS CONCERNING A THEORY OF CRACK PROPAGATION IN METAL FATIGUE
S. R. Valluri (Calif. Inst. of Tech.) J. B. Glassco, and G. E. Bockrath July 1963 44 p refs Presented at Summer Meeting of SAE, Los Angeles, Sept., 1963
(Contract AF 33(616)-6270)
(Engineering Paper 1695; GALCIT-SM-63-15; Pasadena Publ. 563)

The results of the modifications of the metal fatigue theory are: (1) the stress distribution at the tip of the crack is dependent upon the natural plastic stress concentration factor, gross stress, and the crack length; (2) the internal stresses that oppose the motion of dislocations are presumed to decrease continuously due to fatigue; (3) the effect of such a decrease is to give rise to the concept of a "nucleation period" in low stress level fatigue; (4) the rate of crack growth is related to crack length for constant gross section stress; (5) the rate of growth for constant net section stress is not as strongly influenced by the crack length. Author

19 MATERIALS, NONMETALLIC

Includes: mechanical and physical properties of non-metals (e.g., plastics).

***For related information see:* 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.**

N63-23006 Hughes Aircraft Co., Culver City, Calif.
DEVELOPMENT OF REFRACTORY FABRICS Final Summary Report, 1 Oct. 1960–2 Dec. 1962

L. E. Gates and W. E. Lent Apr. 8, 1963 61 p 1 ref
(NASA Contract NAS8-50)
(NASA CR-51750) OTS: $6.60 ph, $2.03 mf

The compositions and fiber-forming characteristics of 25 refractory glass materials are described. The construction and operating details are given for a vertical arc-fiberizing apparatus developed for rapid fiber formation of refractory glasses. The construction and operating procedure of a new high-temperature, glass-melting furnace for fiberizing are described. Glass temperatures in excess of 1850° C are achieved. Evaluations of single fiber properties and the properties of fiber-resin composites are given. The problems of carding brittle fibers are discussed. A testing machine was developed for evaluating high-temperature fabrics under dynamic loading and heating conditions. Author

N63-23032 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
1962 PUBLICATIONS By Engineering Materials Branch [A Compilation of Abstracts]
Jan. 7, 1963 25 p 31 refs
(NASA TM X-50836; MTP-P&VE-M-63-1) OTS: $2.60 ph, $0.95 mf

The mission of the Engineering Materials Branch is to conduct research and development in the fields of chemistry, metallurgy, chemical engineering, physics, and other technologies related to materials in research and engineering. These investigations are conducted in support of the launch vehicle programs. Author

N63-23056 Pennsylvania State U., University Park
MECHANICS OF CREEP AND IMPACT FOR PLASTICS Final Report No. 2, June 30, 1962–June 30, 1963
M. G. Sharma, V. H. Neubert, and Joseph Marin [1963] 8 p 8 refs
(AROD-3263-7)

Progress reported includes the following: (1) Dynamic studies on a linear polymeric material have been conducted at a low frequency range, 0.08 cycles/min to 14 cycles/min. The dynamic properties were evaluated from hysteresis loops obtained at various frequencies and stress levels. From dynamic data storage, modulus and loss modulus as functions of frequency and stress levels were evaluated. (2) Dynamic behavior was predicted from the static properties using a modified superposition principle. (3) A new machine for evaluating dynamic properties, based on the electromagnetic transducer principle, was designed and constructed. (4) The static and dynamic properties of the polymeric material tested, in the time (frequency) scale and in the stress levels used, have been related to the molecular theory of Bueche. (5) The creep behavior of polymeric material under variable load histories was studied. This included the observation of material behavior to various time-dependent load patterns which are periodic in nature. The creep behavior under variable loading conditions has been predicted from static creep data. (6) The behavior of plastic materials under high-strain-rate loading was studied by means of the Hopkins Bar test setup. I.v.L.

N63-23057 Georgia U., Athens
INFRARED SPECTRA OF PLASTICS AND ELASTOMERS AFTER NUCLEAR IRRADIATION Progress Report
Sept. 3, 1963 18 p 15 refs
(Contract AT-(40-1)-2418)

Infrared spectra of plastics and elastomers after nuclear irradiation are reviewed. Unirradiated Marlex 50 polyethylene and polybutene-1 films were melted in a new heated cell to study the effects of melting and resolidification on their infrared spectra. Crystalline and amorphous bands were identified. The G value for transvinylene growth in polybutene-1 during irradiation was found to be approximately 0.30. The effect of melting crystalline polymer films is to reduce the intensity of the out-of-plane hydrogen deformation band of vinyl, transvinylene, and vinylidene olefins. These intensity reductions are too large to be ignored in calculating double-bond concentrations. In melting the crystallites in irradiated polymers, it is imperative to prevent oxidation by heating the film in an oxygen-free atmosphere. Polybutene-1 may have two crystalline forms instead of three as reported by Zannetti, *et al.* A survey was made of the growth and/or decay of double bonds in the various polymers studied. The specific structural and environmental polymer characteristics favoring growth and/or decay of specific olefin groups are still very elusive in spite of the many polymers studied. I.v.L.

N63-23081 Princeton U., N.J. Frick Chemical Lab.
MAXIMUM RELAXATION TIMES IN POLYTETRAFLUOROETHYLENE
M. Takahashi and A. V. Tobolsky Aug. 1963 7 p 5 refs
(Contract Nonr-1858(07))
(ONR-TR-RLT-64)

L. C. Case recently suggested that the result of the author's which shows that the maximum relaxation times in molten polytetrafluoroethylene at 380° C vary as the 0.8 power of the number-average molecular weight, may be due to the reversible dissociation of polytetrafluoroethylene molecules at this temperature. His explanation was based on data of viscosity vs temperature by Nishioka and Watanabe. The authors repeated the experiments with polytetrafluoroethylene below 380° C, with a previously run sample, and it was shown that the values of the maximum relaxation times agreed with experimental error. However, repeating the experiments above 380° C, with the sample used once before at the same temperature, caused a considerable decrease in the maximum relaxation time. This result proves that the irreversible decomposition of polytetrafluoroethylene becomes appreciable only above 380° C. There was no evidence of a reversible or irreversible dissociation of polytetrafluoroethylene at or below 380° C. It is possible that the slightly different "transition" temperatures obtained from the authors' data and the data of Nishioka and Watanabe may be due to a difference in the samples used. The degradation of polytetrafluoroethylene can be affected by monomeric impurities (e.g., slight traces of unwanted comonomers) and by catalyst residues, etc. I.v.L.

N63-23105 Pfaudler Permutit, Inc., Alfred Station, N.Y. Materiadyne
RESEARCH ON THE THERMAL PROPERTIES OF ZIRCONIA
R. B. Burdick and W. R. Hoskyns Wright-Patterson AFB, Ohio Aerospace Research Labs., Sept. 1963 83 p 8 refs
(Contract AF 33(616)-8208)
(ARL 63-170) OTS: $2.25

Thermal expansion, thermal diffusivity, and elasticity measurements, over a range of temperatures, were made for zirconia bodies modified by additions of MgO, Al_2O_3, CeO_2, CaO, Ti, and Zr. The effects of the additives on these thermal properties of zirconia were demonstrated. Specimens of unstabilized monoclinic zirconia were prepared by hot pressing. The elastic moduli of these specimens were measured by a sonic method in the temperature range 25° to 1000° C. Application of mathematical expressions developed for the porosity dependence of elastic modulus of refractory oxides led to the calculation of Young's and shear moduli at zero porosity of this material in the specified temperature range. Author

N63-23234 National Research Corp., Cambridge, Mass.
SPACE MATERIALS FOR THE FUTURE
Robert A. Stauffer and John L. Ham *In* AIAA 2nd Manned Space Flight Meeting [1963] p 260–273 (See N63-23201 24-01)

At the very low gas densities encountered in space, bearings, sliprings, gear trains, and other devices requiring motion between surfaces show increased tendency to cold weld, and normal lubricating techniques cannot be used. Work on cohesive properties of materials at low pressures are described, and possible methods of overcoming cold welding problems are discussed. Recent developments in superconductors are reviewed, and applications for these materials in space vehicles are discussed. Author

N63-23379 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE ISOTOPIC EFFECT IN THE ELECTROSYNTHESIS OF OZONE BY RAYLEIGH'S METHOD
I. A. Tikhomirov and V. N. Melenevskiy Jan. 8, 1963 7 p 3 refs Transl. into ENGLISH from Zhur. Fiz. Khim. (Moscow), v. 36, no. 4, 1962 p 895–897
(FTD-TT-62-1535-1+2+4)

Separation coefficients and the nature of the isotopic effect in the electrosynthesis of ozone were obtained by a method of continuous circulation of oxygen through an ozonizer in a closed circuit and removal of the ozone from the circulating stream by chemical absorption. Experimental results for the separation coefficients and for the dependence of the degree of oxygen–ozone conversion p on time are shown in graphic form. At a degree of conversion of from 45% to 90%, the separation coefficient remains constant and does not depend on p. The average value for the separation coefficient was 1.08. The degree of dependence of the separation coefficient and of O^{18} concentration in the residue on the degree of conversion, is also presented graphically. P.V.E.

N63-23425 Imperial Coll. of Science and Tech., London (Gr. Brit.)
ADSORPTION AND SORPTION COMPLEXES Final Technical Report, July 1, 1962–June 30, 1963
J. L. Whiteman [1963] 22 p refs
(Contract DA-91-591-EUC-2465)

It has been shown that sulphur vapor is sorbed rapidly and copiously by the zeolites CaA and NaX. The uptake of the large cages in these zeolites is only about 75% of that expected from their volumes. This may be ascribed to steric difficulties encountered in packing large molecules into the cages. The sulphur uptake of natural chabazite is comparatively slow and limited in extent. Phosphorus is also strongly sorbed by NaX, but in this case the approach to equilibrium is slow. Further investigations have been conducted into the mercury uptake of silver ion-exchanged zeolites. Large uptakes have been recorded with the zeolites having the more open structures, and hysteresis loops have been obtained. Author

N63-23432 General Electric Co., Fort Wayne, Ind. Component Products Div.
HEAT RESISTANT ADHESIVES
H. B. Bolson Jan. 22, 1963 8 p
(R63FL9)

Two compounded epoxy adhesives, an epoxy novolak and a bisphenol A epichlorohydrin epoxy, were catalyzed with diethylaminopropylethanolcarbamate, heat aged at 125° C, and tensile shear measured at room temperature and at 125° C. Diethylaminopropylethanolcarbamate is not suitable catalyst for selected modified epoxy adhesives (M643 and FW 7248), but is suitable catalyst for certain unmodified epoxy resins (DEN 438 epoxy novolak and Ciba 6010). Author

N63-23496 Du Pont De Nemours (E.I.) and Co., Inc., Wilmington, Del. Experimental Station
THERMOELECTRIC PROPERTIES OF SELENIDES AND TELLURIDES OF GROUPS VB AND VIB METALS AND THEIR SOLID SOLUTIONS Seventh Quarterly Report, Jan. 1–Mar. 30, 1963
W. T. Hicks and H. Valdsaar May 1, 1963 36 p refs

Calculations have been made of idealized efficiencies for various operating conditions and geometries of thermoelectric modules with segmented elements of tantalum-doped tungsten diselenide in combination with sodium-doped lead telluride, encapsulated in constantan cylinders serving as the n-type element. An efficiency of 9.6% was calculated for the combination $W_{0.98}Ta_{0.02}Se_2$ and PbTe + 0.3 at.% Na operating in the gradient 1000° C to 25° C. The power per unit volume is 0.47 watts cm^{-3} compared with 0.19 watts cm^{-3} for PbTe-based modules. Observations on the thermal decomposition of WSe_2 indicate a measurable pressure of Se at 400° C, which remains considerably below 1 atm at 1100° C. Author

N63-23500 Du Pont De Nemours (E.I.) and Co., Inc., Wilmington, Del. Experimental Station
POST-MODIFICATION OF CONJUGATED TRIENE POLYMERS VIA THE DIELS-ALDER REACTION
Vernon L. Bell [1963] 12 p refs Presented in part at Southeastern Regional Meeting, Am. Chem. Soc., Charlotte, N.C., Nov. 14–16, 1963

Polymers from 1,3,5-hexatriene, 1,3,5-heptatriene, and 2,4,6-octatriene were modified by means of the Diels–Alder reaction. Several dienophilic agents were reacted with the polytrienes containing conjugated diene structures to yield cyclic structures incorporated into, and appended to, the polymer backbone. The mild conditions of the postreactions proved to be convenient for the conversion of highly unsaturated polyhydrocarbons into unique polymers bearing cyclic functional substituents. It was proposed that the incomplete reaction of tetracyanoethylene with the 1,3-dienyl groups of the polymer substrates was a result of steric hindrance of the ring structures of the polymer adducts. Author

N63-23503 Westinghouse Electric Corp., Pittsburgh, Pa. Central Research Labs.
MODULE IMPROVEMENT PROGRAM Final Report
Aug. 31, 1962 95 p refs
(Contract NObs-84329)

Data are presented related to the testing of materials for use in power-generator modules. The improvement of life-performance of thermoelectric generator modules was obtained by means of engineering development and evaluation in the areas of insulation, material processing, contacting, stress analysis, and the testing of mechanical properties of materials. Generator module life-performance was represented by the couple technology of the 5-kw generator. Average life was increased from 400 hours for 25-percent drop in power ouput, and initial couple efficiency of five percent, to 7500 hours for 25-percent power drop, with some module tests running in excess of 10,000 hours. Module efficiency was improved to 7 percent for a smaller temperature. Three module sections, with a combined power output slightly above 30 watts, were assembled using the material-couple systems. R.T.K.

N63-23525 Atomics International, Canoga Park, Calif.
ROLE OF PHOSPHORUS IN GROWTH OF BERYLLIA SINGLE CRYSTALS
S. B. Austerman Sept. 30, 1963 18 p 12 refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8361) OTS: $0.50

With lithium phosphate added to the flux in amounts up to several percent, unique beryllia crystal-habit modifications occur, the extent of modification depending upon temperature, flux composition, and phosphate concentration. Also, the temperature for crystal nucleation is slightly lowered, and generation of inclusions, otherwise severe, is markedly suppressed. Phosphorus is not introduced into the crystal from the flux in significant amounts. Author

N63-23552 National Research Council, Washington, D.C. Materials Advisory Board
REPORT OF THE AD HOC COMMITTEE ON PROCESSING OF CERAMIC MATERIALS
Oct. 15, 1963 104 p
(ARPA Contract SD-118)
(MAB-195-M)

Research lacks have been identified in the areas of: preparation and characterization of fine particles; characterization and control of grain boundaries and phase boundaries; subsolidus phase relations and kinetics; control and characterization of agglomerates and granules; densification mechanisms at high temperatures and pressures; gas solubility in solid and liquid ceramics; growth of crystal fibers from the vapor phase; identification and characterization of isolated defects; mechanisms of material removal. Support of empirical development approaches is recommended on: instruments and techniques for material characterization and flaw detection during production; super-pressure forming; hot forming; isostatic hot pressing; hot deposition; finishing; surface conditioning and prestressing. Scale-up studies are suggested on: case history approach in a specific scale-up effort; evaluation of variables in firing large shapes; production by high-temperature moderate-pressure methods of discs up to 12 inches in diameter. Author

N63-23580 General Electric Co., Cincinnati, Ohio Nuclear Materials and Propulsion Operation
COMPUTER PROGRAMS DESCRIBING COLLISION CASCADES IN BINARY MATERIALS. III. BODY-CENTERED CUBIC AND FACE-CENTERED CUBIC STRUCTURES
D. G. Besco and J. R. Beeler, Jr. Aug. 1963 59 p 13 refs
(Contract AT(40-1)-2847)
(GEMP-243) OTS: $1.50

An IBM 7090 computer program simulating radiation damage events in binary materials is described. The present work combines in one program the facility for simulating cascades in body-centered-cubic and face-centered-cubic structures. The computational model is similar to that used in earlier calculations for a square planar lattice and for a wurtzite structure, with refinements in two important areas. The assumption of binary elastic collisions remains, but the collision parameters may be computed from an arbitrarily defined potential rather than restricted to a hard-sphere approximation to the Bohr potential. Author

N63-23618 Bureau of Mines, Minneapolis, Minn.
LIGHTWEIGHT AGGREGATES: EXPANSION PROPERTIES OF CLAYS, SHALES, AND ARGILLITES OF MINNESOTA
Wesley A. Grosh and H. P. Hamlin 1963 34 p refs
(BM-RI-6313)

Samples of clays, shales, and argillites from 21 locations were subjected to preliminary bench-scale tests for bloating properties, and several samples were tested for ceramic properties. Samples showing favorable bloating properties were further tested in a pilot-plant-scale rotary kiln. Physical characteristics and concrete-making properties of the bloated products were determined. The Decorah shale from one area made a suitable material for a lightweight aggregate; however, the limestone layers in the formation must be eliminated or the resulting activated lime must be controlled by quenching. Author

N63-23621 Solar, San Diego, Calif.
EXPLORATION AND EVALUATION OF NEW GLASSES IN FIBER FORM Bi-Monthly Progress Report No. 4, Aug. 16-Oct. 15, 1963
Gunther K. Schmitz Oct. 24, 1963 25 p refs
(Contract Nonr 3654(00) (X))
(RDR 1343-4)

Tests on virgin E-glass fibers have been completed and results are presented. The artificial fiber damage program is in progress on both E- and S-glass. Author

N63-23626 Denver Research Inst., Colo.
DETERMINATION OF THERMODYNAMIC PROPERTIES OF SEMICONDUCTOR MATERIALS Final Report [Apr. 1, 1960-Apr. 30, 1963]
M. J. Pool, R. W. Sullivan, and C. E. Lundin May 28, 1963 60 p refs
(Contract AF 19(604)-7222)
(AFCRL-63-156; DRI-2115)

A diphenyl ether calorimeter and a liquid-tin solution calorimeter were employed to determine selected thermodynamic properties of Group III and V elements and their compounds. The enthalpy and heat capacity of eight Group III-V compounds were determined in the solid state. The compounds are: InP, InAs, InSb, GaP, GaAs, GaSb, AlP, and AlSb. Data were obtained on the enthalpy and heat capacity of the liquids of several of these compounds. Knudsen effusion studies were conducted on pure antimony and a series of alloys of the antimony-germanium systems. Vapor pressures and activities of antimony over the mixtures of these alloys were then established. Heats of vaporization for both pure antimony and of antimony over the alloys are presented. Author

N63-23629 Aerojet-General Corp., Azusa, Calif.
COMPARISON OF NaK AND ORGANICS AS SNAP-8 THIRD LOOP FLUIDS
Jan. 1963 25 p refs
(Rept. 2413)

An evaluation of fluids used in the heat rejection loop (third loop) of the SNAP-8 system has been made. NaK and organics are compared as third loop fluids, and the conclusions drawn are: (1) Potentially serious problems exist with the use of organics due to heat-transfer degradation and gas evolution. However, quantitative data to determine the specific effects for the SNAP-8 environment were not available. (2) There is no significant difference in total weights of both systems based on no allowance either for heat-transfer degradation or for a gas-removal system. (3) The reliability of a NaK system was felt to be significantly higher. The recommendation was made that NaK be chosen as a third-loop fluid. R.T.K.

N63-23648 Atomics International, Canoga Park, Calif.
ROLE OF BORON IN GROWTH OF BERYLLIA SINGLE CRYSTALS
S. B. Austerman Sept. 30, 1963 17 p 10 refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8403) OTS: $0.50

The influence of boron in the growth of BeO single crystals from lithium molybdate flux has been studied. The concentration of $LiBO_2$ was varied from 0.05 to 5 wt. % of the MoO_3 flux component. Throughout this entire range, the crystal habit and characteristics of growth in the negative and positive polar directions were considerably modified. The supersaturation level required for crystal nucleation and significant growth rate was markedly reduced. The boron was found to enter the crystal lattice, without detectably altering lattice constants, and, in some cases, to introduce a distinctive reduction in crystal symmetry. Author

N63-23662 Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
TRANSLUCENT OXIDES
W. J. Gardner, J. D. Mc Clelland and J. H. Richardson Sept. 13, 1963 40 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-191; TDR-269(4240-01)-1)

Pure oxide powders of aluminum, beryllium, and magnesium were formed into dense translucent compact bodies by hot pressing. The densities of the bodies were found to be more than 98 percent of the theoretical for the MgO, and more than 99.5 percent for the Al_2O_3 and the BeO. Thermal expansion was measured with a Leitz dilatometer. The data are in agreement with previous published values. Thermal conductivity, modulus of rupture, elastic properties, Young's modulus, shear modulus, dielectric constants, and transmission spectra measurements also are presented. Author

N63-23730 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
PROPERTIES OF BLENDED BARIUM AND STRONTIUM FERRITES
Ye. S. Borovik and N. G. Usikova Jan. 4, 1963 11 p refs
Transl. into ENGLISH from Fiz. Metal. Metalloved., v. 13, no. 3, 1962 p 470–474
(FTD-TT-62-1539/1+2+4)

Research on the magnetic properties and several physical properties of blended hard ferrites of composition $Ba_{1-x}Sr_xO \cdot 6Fe_2O_3$ are discussed, and a nonmonotonic relationship between properties and composition is observed. For a 1200° sintering temperature, the magnetic properties of the blended ferrites are poorer than in pure ferrites. The curve of the maximum magnetic energy $(BH)_{max}$ as a function of the composition has a minimum for the ferrite $Ba_{0.5}Sr_{0.5}O \cdot 6Fe_2O_3$ and a maximum for $Ba_{0.7}Sr_{0.3}O \cdot 6Fe_2O_3$. The magnitude of the $(BH)_{max}$ curve for $Ba_{0.7}Sr_{0.3}O \cdot 6Fe_2O_3$ specimens at sintering temperature 1230° attains a value of 1.45×10^6 gs·oe [sic], almost 70% more than in pure barium ferrite, and almost 50% more than in pure strontium ferrite. P.V.E.

N63-23732 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
PHOSPHIDES (SELECTED PARTS)
G. V. Samsonov and L. L. Vereikin Mar. 12, 1963 29 p
Transl. into ENGLISH from the book "Fosfidy," Izdatel'stvo AN Ukrainskoy" SSR, Kiev, 1961 p 3–4, 45–54, 68–70, and 114–118
(FTD-TT-1763/1+2)

This review of phosphides includes: (1) the preparation, structure, and chemical and physical properties of: vanadium phosphides, niobium phosphides, tantalum phosphides, chromium phosphides, molybdenum phosphides, tungsten phosphides, thorium phosphides, uranium phosphides, neptunium phosphides, and plutonium phosphides. Also, the areas in which the alloys of phosphorus are employed are discussed. These areas include semiconductors, soldering techniques, metallurgy, surface coatings for machine parts, chemistry, astrochemistry, and pyrotechnics. I.v.L.

N63-23733 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
STATISTICAL THEORIES OF STRENGTH AND THEIR APPLICATION TO METALLOCERAMIC MATERIALS (SELECTED PARTS)
G. S. Pisarenko and V. T. Troshchenko Apr. 22, 1963 104 p
Transl. into ENGLISH from the book "Statistichni Teorii Mitsnosti Ta Ikh Zastosuvannya Do Metalokeramichniki Materialiv" Vidavnitstvo Akad. Nauk Ukrains'koy RSR, Kiev. 1961 p 13–19 and 40–102
(FTD-TT-62-1765/1+2)

Studies of the statistical theories of strength and their application to metalloceramic materials cover the following areas: (1) peculiarities of the breakdown of brittle metalloceramics, (2) statistical theories of brittle strength, and (3) investigation of the laws governing the breakdown of heat-resistant metalloceramic materials. P.V.E.

N63-23743 Hercules Powder Co., Cumberland, Md.
THE EFFECT OF PENETRANTS ON GRAPHITE, UNDER FIRING CONDITIONS
W. R. Christopher Oct. 1963 21 p
(Contract NOrd-16640)
(ABL/X-105)

In preparing rocket motors for firing, penetrants are sprayed onto the gas-side surfaces of graphite nozzle-throat inserts to facilitate prefiring inspection. A study was made to determine the effects, if any, of such penetrants on the erosion rates of graphites. For this study, throat area changes were measured after firing twelve EM-4 test motors (EJC propellant), six motors incorporating ATJ graphite throat inserts and six pyrolytic graphite inserts. These inserts had been (1) sprayed with Partek® (Black-lite) penetrant, (2) sprayed with alcohol penetrant, or (3) left unsprayed. Examination of the throat inserts after the firings and of the data obtained disclosed no difference in the appearance or erosion rates. It is concluded that a fluorescent (Partek) penetrant has no detrimental effect on graphite. Author

N63-23796 Narmco Research & Development, San Diego, Calif
DEVELOPMENT OF ADHESIVES FOR VERY LOW TEMPERATURE APPLICATION Quarterly Summary Report
M. Bruce Smith and Samuel E. Susman Oct. 15, 1962 50 p
(NASA Contract NAS8-1565)
(NASA CR-52279) OTS: $4.60 ph, $1.70 mf

Considerable work has been done with adherend surface preparations for optimizing adhesive strength and toughness at very low temperature, with emphasis on chemical etches for field application. Data are required for miscellaneous studies aimed at upgrading cryogenic adhesive properties—composite adhesives, metallic solder bonds, filled and fabric supported systems, polyurethanes, primes, etc. LOX compatibility and mechanical shock data at −423° F are reported. Three new adhesive systems have been selected and partially evaluated which demonstrate faster cure at RT, superior peel strength at very low temperature, and LOX compatibility, respectively. Author

N63-23797 Narmco Research & Development, San Diego, Calif.
DEVELOPMENT OF ADHESIVES FOR VERY LOW TEMPERATURE APPLICATION Quarterly Summary Report

M. Bruce Smith and Samuel E. Susman Jan. 15, 1963 32 p
(NASA Contract NAS8-1565)
(NASA CR-52278) OTS: $3.60 ph, $1.16 mf

Four RT-curing developed adhesives have been evaluated against a series of aluminum, stainless, and titanium alloys. Although acceptable strengths were obtained at RT and −320° F, 6061-T6 aluminum and 301 stainless were the most difficult alloys to adhere to. A series of adhesive studies was undertaken to improve adhesives for liquid hydrogen application. Intensive effort has been directed toward the development of adhesive systems which would be compatible with liquid oxygen. Fluoroplastic films heat-sealed to adherends are lox compatible and have very attractive adhesive strengths. Author

N63-23798 Narmco Research & Development, San Diego, Calif.
DEVELOPMENT OF ADHESIVES FOR VERY LOW TEMPERATURE APPLICATION Quarterly Summary Report
M. Bruce Smith and Samuel E. Susman July 15, 1962 44 p
(NASA Contract NAS8-1565)
(NASA CR-52281) OTS: $4.60 ph, $1.52 mf

New nylon-epoxy and polyamide-epoxy compositions have failed to show any promise for low-temperature adhesives because the high molecular weight precludes processing at ambient temperature. One epoxy-polyamide adhesive has been investigated which cures fast and develops improved ambient and low-temperature strengths. Fibrous type fillers appear to offer no advantage over powdered fillers in epoxy-polyamide adhesives. Mechanical shock, impact strength, butt tensile strength, compression strength, temperature cycling, cure time dependence, glueline thickness, postcure, and mismatched details data have been generated for the developed adhesive systems. Author

N63-23803 Aerojet-General Corp., Sacramento, Calif. Solid Rocket Plant
RESEARCH AND DEVELOPMENT IN SUPPORT OF THE POLARIS PROGRAM. TASK IV: DEVELOPMENT OF IMPROVED RESIN SYSTEMS FOR FILAMENT-WOUND STRUCTURES [Second Bimonthly Progress Report] 9 July-9 Sept. 1963
J. J. Cooney and S. Brelant Oct. 31, 1963 20 p
(Contract NOw 63-0627c(FBM))
(Rept. 0627-VI-2)

This second bimonthly progress report presents analyses of epoxy resins and curing agents, describes the calculation of the resin-system formulations, the development of casting techniques that would produce void-free test specimens, and the development of test procedures and equipment required for this program. Author

N63-23807 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
MEASURED EFFECTS OF THE VARIOUS COMBINATIONS OF NUCLEAR RADIATION, VACUUM, AND CRYOTEMPERATURES ON ENGINEERING MATERIALS Quarterly Progress Report, June 1-Aug. 31, 1963
E. E. Kerlin and E. T. Smith Sept. 30, 1963 122 p
(NASA Contract NAS8-2450)
(NASA CR-52319; GD/FW-FZK-172) OTS: $10.10 ph, $3.86 mf

Progress is reported in investigations in the following areas: (1) combined effects of radiation and vacuum, (2) combined effects of radiation and cryotemperatures and (3) combined effects of radiation, vacuum, and cryotemperatures. P.V.E.

20 MATHEMATICS

Includes: calculation methods and theory; computers; data processing; and numerical analysis.

For related information see: 08 Communications; 09 Electronics; 10 Facilities; and 22 Navigation and Guidance.

N63-23001 Rome Air Development Center, Griffiss AFB, N.Y.
GENERATION OF ERROR VECTORS
Alfred Kobos Sept. 1963 10 p
(RADC-RAU-TM-63-6)

In experiments with digital data sources, it is often required to generate a repeating digital waveform whose period is a binary sequence. A method is presented by which any arbitrary waveform can be generated, using a minimum number of shift register stages and standard circuitry consisting of modulo-two adders, multipliers, and inverters. The particular case where the period consists of all possible binary n-tuples is examined. This is of interest because it contains all the error vectors which may be added in transmission. The 16 waveforms which contain all the 4-tuples are derived. The connections of this study with other mathematical disciplines (such as topology, directed graphs, and state diagrams) are discussed. Author

N63-23004 Stanford U., Calif. Applied Mathematics and Statistics Lab.
IRRATIONAL FRACTION APPROXIMATIONS TO MILL'S RATIO
Harold Ruben July 31, 1963 14 p 6 refs
(Contract Nonr-225(52))
(Tech. Rept. 89)

A new expansion for Mill's ratio for the normal probability integral, R(x), is devised in terms of irrational fractions. This expansion is asymptotic and convergent for all $x > 0$. The individual terms are determined explicitly in algebraic form, and the upper bounds for the truncation errors are established. Numerical examination suggests that the convergence is more rapid than in the Shenton series of irrational fraction approximations, based on the convergents of Laplace's continued fraction representation of R(x) ($x > 0$). The accuracy of the Nth order approximations to R(x) was determined numerically, and the tabulated results show that the approximations derived in this paper are superior to those of Shenton for moderate or high values of $x (x \geq 4)$, whereas Shenton's approximations are more accurate for low values of x. Also, Boyd's lower and upper bounds were found to provide good first approximations to R(x) over the tabulated range of x. M.P.G.

N63-23038 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DOCUMENTATION OF THE TIROS III DATA REDUCTION PROGRAM
Lena Fried Dec. 18, 1962 90 p
(NASA TM X-50729; NASA X-543-62-227) OTS: $8.10 ph, $2.90 mf

Documentation of the Tiros III data-reduction program is presented. The following parts of the program are presented and discussed: (1) detailed breakdown of the program's executive routine, including the generation of the Final Meteorological Radiation Tape (FMRT); (2) subroutines which give calling sequence, purpose, and method of solution; (3) sense switch and indicator bit settings; (4) diagnostic counters used in program; (5) program inputs

which include documentation card, radiation tape documentation record, and format of the orbital tape; and (6) flow chart of subroutine "DIRECT." P.V.E.

N63-23055 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ON THE SUM OF THE RECIPROCALS OF THE FERMAT NUMBERS AND RELATED IRRATIONALITIES
Solomon W. Golomb [1962] 4 p 1 ref
(NASA Contract NAS7-100)

A conceptually simple scheme is used to show that certain functions, F(z) and G(z), take on irrational values whenever $z = 1/t, t = 2,3,4,5, \ldots$ and, in particular, the irrationality of the sum of the reciprocals of the Fermat numbers. C.L.W.

N63-23085 Florida State U., Tallahassee
THE DEVELOPMENT OF STATISTICAL METHODS FOR QUALITY CONTROL AND SURVEILLANCE TESTING: SEQUENTIAL RANK TESTS Technical Report No. 7
Ralph A. Bradley Apr. 1963 12 p 9 refs Presented at the 5th Intern. Biometric Conf., Cambridge, Mass.
(Contract Nonr-988(08))

Two-sample, sequential rank tests which were developed from the Lehmann model of the two-sample rank-sum test for testing the difference in locations for two populations are investigated. The standard sequential probability-ratio method of Wald was used for pairs of samples of sizes m and n taken sequentially, the ranking effected within each group of two samples. Certain extensions of the Wald sequential procedure are examined, and consideration is given to departures from the Lehmann model. C.L.W.

N63-23152 Hercules Powder Co., Cumberland, Md. Allegany Ballistics Lab.
POLARIS A3 SECOND-STAGE AFT DOME PHOTOSTRESS STUDY Final Report
J. A. Levens, J. P. Lucas, and R. F. Horn Mar. 1963 21 p 5 refs
(Contract NORd-16640)
(ABL/X-86)

A relatively new analytical technique, PhotoStress, was applied in a strain distribution study of the Polaris A3 second-stage chamber in the region of the nozzle and center port openings of the aft dome. This paper presents primary (P) and secondary (Q) strain trajectories, the magnitude of differences in strain (P-Q) over a quadrant of the dome, and a polar plot of the primary strain around the nozzle ports. Recommendations are made to obtain additional data about individual strain magnitudes, and more accurate determination of strain directions on filament-wound composites by strain gage placement and PhotoStress techniques. Author

N63-23192 European Atomic Energy Community, Brussels (Belgium)
APACHE SUB-ROUTINE FOR THE AUTOMATIC INTRODUCTION OF FIXED AND VARIABLE DELAY FUNCTIONS IN ANALOG PROBLEMS [SOUS-ROUTINE APACHE POUR L'INTRODUCTION AUTOMATIQUE DES FONCTIONS-RETARD FIXES ET VARIABLES DANS LES PROBLEMES ANALOGIQUES]
J. Gamp Joint Nucl. Res. Center, Ispra Estab. (Italy), June 1963 64 p 11 refs In FRENCH
(EUR 347.f) Available from Belgian American Bank and Trust Co., N.Y., account No. 121.86: 85 Belg. Fr.

Of the approximations which may be used to represent the delay function, that of Padé has been shown by an accuracy study to be among the best; it also permits a simple extension to high orders. The APACHE code permits a systematic method of scaling and also a subroutine which calculates the coefficients and static check values for any order from 2 to 20, and for any input. The delay may be fixed or variable. Author

N63-23411 California U., Los Angeles
APPROXIMATION THEORY
E. W. Cheney Aug. 1963 150 p 102 refs
(Sponsored by ONR and Army Res. Office)

Various theorems, corollaries, and lemmas dealing with the approximation theory are presented and solved. I.v.L.

N63-23426 Georgia U., Athens Inst. of Statistics
ESTIMATION IN MIXTURES OF DISCRETE DISTRIBUTIONS
A. Clifford Cohen, Jr. Aug. 15, 1963 11 p refs
(Contract DA-ARO(D)-31-124-G55)
(Tech. Rept. 12)

Parameters of mixed distributions are estimated using sample moments and sample zero frequencies. Mixtures consisting of two complete Poisson distributions, two truncated Poisson distributions, and a Poisson combined with a binomial distribution are considered. Author

N63-23553 Joint Publications Research Service, Washington, D.C.
PRACTICAL APPLICATION OF MATHEMATICS AND COMPUTERS
Tiberiu Popovici (Rumania) Sept. 10, 1963 8 p Transl. into ENGLISH from Tribuna (Bucharest), v. 7, no. 26 (334), June 27, 1963 p 1 and 8
(JPRS-21006; OTS-63-31720) OTS: $0.50

Mathematical programing and the use of computers are discussed in the light of the following applications: (1) cybernetics; (2) the automatic registration of the course of activity in an industrial plant in order to correct irregularities, (3) the determiniation of the most advantageous technical procedure for manufacturing a given product, (4) the petroleum-extraction industry, (5) the most economical planning of transportation, (6) the organization of documentation, (7) the determination of the most economical blast furnace, and (8) the computation of the contours of helical milling tools for the processing of stereotype rolls. I.v.L.

N63-23561 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
INFORMATION PROCESSING RELEVANT TO MILITARY COMMAND: SURVEY, RECOMMENDATIONS AND BIBLIOGRAPHY, VOLUME II (BIBLIOGRAPHY APPENDIX) Final Report
A. E. Murray and H. R. Leland Feb. 1963 64 p 223 refs
(Contract AF 19(628)-1625)
(ESD-TDR-63-349)

N63-23579 American Inst. for Research, Pittsburgh, Pa.
AN EXPERIMENTAL INVESTIGATION OF INTELLIGENCE INFORMATION DISPLAY PARAMETERS
A. J. Hoisman, L. D. Hannah and E. Scharf Griffiss AFB, N.Y., Sept. 1963 189 p 23 refs
(Contract AF 30(602)-2696)
(RADC-TDR-63-378)

Information presentation parameters of visual displays used by Air Force intelligence analysts were investigated. Maps, linear graphs, and tables were chosen as the most representative means of display information. An investigation of the variables within these display methods led to the selection of the following as the most potentially critical parameters: (1) density—defined as the total number of symbols in a given

area; (2) density—defined as the number of symbol classes within a given area; and (3) color-coding. Results indicate: (1) that increasing the density of a display (in terms of both the absolute number of symbols and the number of symbol classes) results in a systematic reduction of performance; (2) that the addition of a color, as an enhancement of a symbol's distinguishability, does not increase performance and may even lessen it; (3) that there were no differences in performance based on task category; and (4) that tables and graphs displaying identical information do differ markedly in terms of performance. When performance is measured in terms of speed of response, graphs are the more effective display method; when the measure is accuracy, tables are the better method. I.v.L.

N63-23593 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Va.
TOWARDS AN EMPIRICAL CALCULUS OF REINFORCEMENT VALUE
Thom Verhave Repr. from J. Exptl. Analysis of Behavior, v. 6, no. 4, Oct. 1963 p 525-536 refs

If an animal can be made to produce one of two alternative conditions (schedules, reinforcers, etc.) via a switching or choice key, a preference can be demonstrated for the condition produced by the choice key. The degree of preference of an organism for one stimulus condition over another was investigated. The subjects were white Carneaux pigeons. A quantitative index of preference was obtained. A specific value, in terms of a rather specific number of responses the bird settles at on a choice key, was measured. This equilibrium value was employed as a dependent variable, and several variables of which it is a function were explored. R.T.K.

N63-23610 Naval Ordnance Lab., White Oak, Md.
FNOL2, A FORTRAN (IBM 7090) SUBROUTINE FOR THE SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS WITH AUTOMATIC ADJUSTMENT OF THE INTERVAL OF INTEGRATION
Jerry S. Linnekin and L. J. Belliveau July 17, 1963
(NOLTR 63-171; Math. Dept. Rept. M-38)

FNOL2 is a FORTRAN subroutine used for the numerical integration of a system of up to 30 ordinary differential equations. It uses double precision arithmetic in key locations. FNOL2 has the option of automatically varying the interval of integration, h, to hold the relative or absolute truncation error within bounds fixed by the user. A FORTRAN listing of the subroutine is included in this report. Author

N63-23816 Purdue U., Lafayette, Ind.
ON FINDING QUADRATIC FACTORS OF POLYNOMIALS
Andre Georges Vacrous (Ph. D. Thesis) June 1963 142 p refs
(NASA Grant NsG-28-59)
(NASA CR-52238) OTS: $11.00 ph, $4.46 mf

Few simple methods exist which permit the rapid determination, by hand calculation, of complex zeros of polynomials. One of these methods has been proposed by R. Oldenburger and consists in the repetition of a right to left synthetic division, the same method also being available for determining real zeros. However, this method does not converge for every polynomial. The main purpose of this work has been the study of the convergence of Oldenburger's method, which is considered as an iteration process. The conditions of convergence are determined. A geometrical interpretation is given in the complex plane for the particular case of lower order polynomials. The convergence occurs according to certain patterns, depending upon the roots of the given equation, and it is shown how the knowledge of these patterns allows the finding of the roots to be accelerated. Author

21 METEOROLOGY

Includes: climatology; weather forecasting; lower atmosphere studies; and oceanography.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N63-23066 Air Weather Service, Scott AFB, Ill.
RELATIVE HUMIDITY ERRORS RESULTING FROM AMBIGUOUS DEW-POINT HYGROMETER READINGS
H. S. Appleman Sept. 1963 9 p 9 refs
(AWS-TR-171)

Consideration is being given to replacing the current devices for measuring surface humidity with a dew-point hygrometer, largely because of the greater accuracy of the hygrometer in measuring humidities at low temperatures. However, for a considerable temperature range below 32° F, ambiguity can arise as to whether the instrument is measuring dew point or frost point, which negates the value of an accurately measuring hygrometer. There are three possible solutions to this problem. One might be the personal observation of the mirror surface by an observer trained to differentiate between a frost and dew point deposit. Secondly, a technique might be employed to ensure the freezing of the deposit at all mirror temperatures below 32° F by coating the mirror with silicone varnish containing silver iodide particles. The third approach might be to initially lower any below 32° F mirror temperature sufficiently (e.g., to −40° F) to ensure freezing, then to raise it back to the frost-point temperature. Once a mirror deposit has frozen, it will remain as frost as long as (1) its temperature stays below 32° F and (2) the deposit is not completely evaporated. I.v.L.

N63-23079 Air Weather Service, Scott AFB, Ill.
ESTIMATING WIND FORECAST ERRORS FOR SPECIFIC LOCATIONS, ALTITUDES AND SEASONS
K. R. Johannessen Sept. 1963 13 p 6 refs
(AWS-TR-170)

Information is presented which is sufficient to form a pattern of the forecast errors which can be expected in a particular area of interest. This information consists of a determination of the quality of forecasts versus wind variability, the standard vector deviation of the wind, and the wind variability as a function of time. Representative time vs altitude results for two sample areas in the Northern Hemisphere of about 200,000 square miles each, one in high latitudes and the other in middle latitudes, are plotted for summer and winter. These graphs are based on the assumption that a wind sounding to 100,000 ft. is available close to the area of validity shortly before forecasting time. The forecast errors are found to closely approximate a circular normal distribution, so that the probabilities that the forecast error will fall within a given domain can be calculated. M.P.G.

N63-23155 Naval Research Lab., Washington, D.C.
AUTOMATIC WEATHER STATION (GRASSHOPPER). PART I — DESIGN AND MODIFICATIONS 1955-1961
T. E. Marshall III Aug. 13, 1963 41 p 5 refs
(NRL-5966)

As part of a continuing program to develop means for obtaining meteorological data from remote or inaccessible regions, an automatic weather station (Grasshopper) has been developed which is capable of telemetering data from a 15-watt (input to the final) transmitter over distances of hundreds of miles every six hours for several months. Present models of this station contain sensors for wind direction, wind speed, air temperature, and barometric pressure. The station transmits in international Morse code in three-letter groups at a word rate of 17 groups per minute which is satisfactory for monitoring by conventional receiving equipment. The received Morse code is converted to weather data by calibration charts supplied with each station. The accuracy of the transmitted weather data is equivalent to a manned station. Author

N63-23328 Joint Publications Research Service, Washington, D.C.
RECENT DEVELOPMENTS IN METEOROLOGY – USSR
Sept. 27, 1963 42 p refs Transl. into ENGLISH of selected items from Meteorol. i Gidrol. (Moscow), no. 8, 1963 (JPRS-21242; OTS-63-31838) OTS: $1.25

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1. CORRELATION ANALYSES OF CIRCULATION INDICES A. A. Filippova p 11–17 refs (See N63-23329 24-21)
2. NOTES ON THE PROBLEM OF DETERMINING THE LEVEL AND CHARACTER OF THE TROPOPAUSE D. A. Tarasenko p 18–22 refs (See N63-23330 24-21)
3. IS STRATOSPHERE SOUNDING BY AIRPLANE NECESSARY? V. A. Dzhordzhio and N. N. Romanov p 23–24 (See N63-23331 24-21)
4. "ELECTRICAL MEASUREMENT OF AEROPHYSICAL VALUES," BY L. G. KACHURIN, PUBLISHED BY PUBLISHING HOUSE OF LENINGRAD UNIVERSITY, 1962: A REVIEW F. Y. Klinov p 25–27 (See N63-23332 24-21)
5. LITERATURE ON METEOROLOGY AND HYDROLOGY FOR 1962 [REFERENCE LIST] p 28–39

N63-23329 Joint Publications Research Service, Washington, D.C.
CORRELATION ANALYSES OF CIRCULATION INDICES
A. A. Filippova *In its* Recent Develop. in Meteorol., Sept. 27, 1963 p 11–17 refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 8, Aug. 1963 (See N63-23328 24-21) OTS: $1.25

Atmospheric circulation indices, I_z (zonal), I_m (meridional), and I' (general), were calculated for all days of the six-year period 1954 to 1959, according to the method of Kats. Autocorrelation functions and mutual correlation functions were calculated for indices I_z and I_m for three two-year periods. The self-correlation function of I' was calculated for the period 1958 to 1959. Results indicate that: (1) the calculations which were performed confirmed the conclusion reached by Kats, namely, that the indices I_z and I_m are independent characteristics of the state of the atmospheric circulation; (2) the small degree of the mutual correlation of indices I_z and I_m does not permit an improvement in the statistical predictions of each of the indices individually, through the use of the theory of forecasting multidimensional random processes. I.v.L.

N63-23330 Joint Publications Research Service, Washington, D.C.
NOTES ON THE PROBLEM OF DETERMINING THE LEVEL AND CHARACTER OF THE TROPOPAUSE
D. A. Tarasenko *In its* Recent Develop. in Meteorol., Sept. 27, 1963 p 18–22 refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 8, Aug. 1963 (See N63-23328 24-21) OTS: $1.25

The opinions of various countries relative to the determination of the tropopause by the WMO are presented. The following countries considered the existing determination of the tropopause to be essentially satisfactory: Australia, Britain, India, Canada, Poland, and the United States. The following countries considered the determination as unsatisfactory: Denmark, Israel, the Soviet Union, and the South African Republic. I.v.L.

N63-23331 Joint Publications Research Service, Washington, D.C.
IS STRATOSPHERE SOUNDING BY AIRPLANE NECESSARY?
V. A. Dzhordzhio and N. N. Romanov *In its* Recent Develop. in Meteorol., Sept. 27, 1963 p 23–24 Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 8, Aug. 1963 (See N63-23328 24-21) OTS: $1.25

Fast main-line aircraft, capable of reaching altitudes of from 12 to 20 km, will be developed in the near future. A study of stratospheric conditions which these aircraft will encounter can be conducted only by means of regular upper-air soundings by aircraft; thus, radiosonde cannot replace observations made from an aircraft. However, the joint analysis of radiosonde data and observations from sounding aircraft will make it possible to study more fully the phenomena which are of interest to fast high-altitude aircraft. I.v.L.

N63-23332 Joint Publications Research Service, Washington, D.C.
"ELECTRICAL MEASUREMENT OF AEROPHYSICAL VALUES," BY L. G. KACHURIN, PUBLISHED BY PUBLISHING HOUSE OF LENINGRAD UNIVERSITY, 1962: A REVIEW
F. Ya. Klinov *In its* Recent Develop. in Meteorol., Sept. 27, 1963 p 25–27 Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 8, Aug. 1963 (See N63-23328 24-21) OTS: $1.25

A review of the book "Electrical Measurement of Aerophysical Values" by L. G. Kachurin is presented. This book includes chapters on: (1) the basic principles of electric, magnetic, and other transformers, amplifiers, synchronizing devices, recording systems, etc; (2) measuring devices such as radiation and acoustic thermometers, radiation hygrometers, thermal-conductivity hygrometers, delayed-reaction anemometers, and thermal anemometers; (3) descriptions of radiometric methods of certain meteorological measurements (soil humidity, air pressure, velocity of air streams, etc.); and (5) remote methods of meteorological measurements using both wire and radiotelemetry apparatus. I.v.L.

N63-23356 McGill U., Montreal (Canada) Arctic Meteorology Research Group
KINEMATIC DIVERGENCE AND LARGE-SCALE ENERGY CONVERSION Scientific Report No. 8
Amos Eddy July 1963 118 p 21 refs
(Contract AF 19(604)-8431)
(*Its* Publ. in Meteorology 60; AFCRL-63-840)

Experimental evidence is presented in support of the hypothesis that real, large-scale divergence and energy conversion processes can be analyzed from the winds and temperatures reported by the present North American rawinsonde network. The Bellamy triangle method has been used to produce divergence, and this divergence is shown to have continuity in the horizontal, the vertical, and in time. A discussion of the scale on which this parameter can be

analyzed objectively, and the errors involved, are presented. Energy conversion processes associated with an individual weather system are displayed in map form for comparison with other synoptic features. Author

N63-23430 Army Electronics Research and Development Activity White Sands Missile Range, N.Mex.
NIKE-APACHE SR-015 Meteorological Data Report
Gordon L. Dunaway Oct. 1963 21 p 1 ref
(ERDA-72)

Meteorological data gathered for the launching of Nike-Apache SR-015 are presented along with calculated ballistic data. Author

N63-23438 Weather Bureau, Washington, D.C. Meteorological Satellites Lab.
METEOROLOGICAL SATELLITES AND WEATHER FORECASTING
David S. Johnson *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 19–34 (See N63-23436 24-01)
(Lecture 2)

The impact of meteorological satellites on operational weather forecasting is discussed. Meteorological satellites gave the first measurements over an area broad enough to be comparable with the scale of atmospheric motions and with a frequency in time and space compatible with forecasting techniques. At present, weather data from TIROS satellites are processed at two receiving stations, and cloud analyses based on these data are available at the National Meteorological Center in less than four hours. These analyses are also broadcast by various Naval stations, and coded versions are available to countries served by the international teletypewriter net. The success of the TIROS satellites has resulted in a plan for an Operational Meteorological Satellite System whose goal is to assure that at least one Nimbus satellite is operating in orbit all the time, thus providing at least two observations a day of every point on the earth's surface. A future international weather service is envisioned, with a major contribution from meteorological satellites. M.P.G.

N63-23444 Weather Bureau, Washington, D.C.
SPACE RESEARCH AND METEOROLOGY
Harry Wexler *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 123–137 (See N63-23436 24-01)
(Lecture 9)

The value of satellite photographs in operational weather forecasting, as well as in determining the overall global energy budget, is discussed. In addition to the television cameras which record the degree of cloud organization and the scale of local activity in atmospheric motions, the later TIROS and Explorer satellites carried radiation sensors. A preliminary analysis of the radiation data obtained has revealed useful information on the geographic areas of net radiative gain or loss, the temperatures of the earth's surface and of the cloud tops, and the approximate heights of the cloud tops. Tentative correlations between weather developments and atmospheric motions as related to radiation unbalances are being found. Satellites also offer unique opportunities to study large-scale variations in climate, such as warming and cooling trends. International cooperation in meteorological research may eventually lead to the long-range anticipation and perhaps alleviation of changes in weather. M.P.G.

N63-23548 Joint Publications Research Service, Washington, D.C.
WEATHER FORECASTING AND PROBLEMS OF ATMOSPHERIC PHYSICS
In its Sov. Atmospheric and Marine Res. Oct. 11, 1963 p 1-3 Transl. into ENGLISH from Vestnik Akad. Nauk SSSR (Moscow), no. 8, 1963 p 76–77 (See N63-23547 24-01)

A discussion is given concerning improvement in the reliability and time scope of weather forecasts through the working out of effective methods for utilizing data obtained from meteorological satellites, the computation of supplemental physical factors, and the creation of experimental schemes for short-term forecasting. These schemes are to afford (1) improved reliability with a lowering of error in the forecasting of meteorological fields by 15% to 25%, and simultaneous enlarging of the time scope of forecasting, (2) the working out of physically based recommendations for a choice of parameters describing the external nonadiabatic influences on atmospheric processes, and (3) clarification of the nature of the physical processes in the earth's atmosphere that correspond to the appearance of prolonged anomalies in weather. C.L.W.

N63-23560 Army Electronics Research and Development Activity, White Sands Missile Range, N.Mex.
STATISTICAL DATA ON ATMOSPHERIC DESIGN PROPERTIES ABOVE 30 KM
Marvin Diamond and Robert P. Lee Oct. 1963 40 p 7 refs
(ERDA-75)

Meteorological data collected by the Meteorological Rocket Network have been used to derive 1, 5, and 10 percent probability limits for atmospheric temperatures, scalar wind speed, and vector wind shear above 30 km for various geographic zones of North America. Author

N63-23569 California U., Livermore. Lawrence Radiation Lab.
BASE SURGE ANALYSIS Final Report, Nov. 1962-Feb. 1963
J. B. Knox and R. Rohrer Sept., 1963 37 p refs
(PNE-304) OTS: $0.40

This report summarizes and presents the data concerning the base-surge cloud radius and base-surge cloud height as a function of time for the Pre-Buggy series of high explosive shots. An analysis of this information from the Pre-Buggy sequence yields the development of empirical relationships between (1) the maximum base-surge radius (cross wind) and the degree of atmospheric instability, and (2) the maximum base-surge radius (cross wind) in a neutral atmosphere and the scaled depth of the explosive in an alluvium medium. These two developed empirical relationships have important practical use for the preparation of predicted cloud geometries for future Plowshare events. Author

N63-23604 Joint Publications Research Service, Washington, D.C.
CRYSTALLIZATION IN SUPERCOOLED CLOUDS
V. I. Belyayev (Acad. Sci. Ukr. SSR) Oct. 18, 1953 10 p refs Transl. into ENGLISH from Doklady Akad. Nauk SSR (Moscow), v. 151, no. 4, Aug. 1963 p 841–844
(JPRS-21495; OTS-63-31961) OTS: $0.50

An approximate theory for the propagation of crystallization in supercooled clouds is presented. This theory takes into account the precipitations of ice crystals from the cloud, and is thus acceptable for the entire period of propagation of crystallization in clouds. Results obtained, using this theory, indicate that the study of crystallization in supercooled clouds could, in the

first approximation, be used in the solution of a pure diffusion problem of the crystal concentration n_2. The process of the formation of the concentration n_2 is considered to be infinitely slow in comparison with the process in the zone, and the zone dimensions infinitely small in comparison to the dimensions of the cloud in which ice seed propagation takes place. As a supplementary condition for the diffusion problem, it is necessary to take: $n_2 = 0$, where $n_2 \leq n_2^*$ (n_2^* is the frontal concentration).

I.v.L.

N63-23657 National Severe Storms Project, Kansas City, Mo.

THE THUNDERSTORM WAKE OF MAY 4, 1961

Dansy T. Williams Washington Weather Bureau Aug. 1963 27 p refs

(NSSP-18)

The thunderstorms occurring during the night of May 3-4, 1961 have been studied to show the features of the thunderstorm wake. In this region, to the rear of the active thunderstorm, there is a fall in surface pressure which is called the wake depression. It is a hydrostatic pressure fall which results as warm dry air is produced aloft by subsidence at the trailing edge of the thunderstorms. The thunderstorm wake is most pronounced in the dissipating thunderstorm system, and the warm, dry air produced may locally reach the surface, as the warm wake. The warm dry air may have its moisture restored rapidly by horizontal advection, and by the evaporation of the earlier rainfall. The production of considerable warm, dry air aloft, and the rapid acquisition and vertical transport of moisture from the surface, provides an air mass which continues to be thermodynamically favorable for additional thunderstorm activity. Author

N63-23679 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE AUTOMATIC PICTURE TRANSMISSION (APT) TV CAMERA SYSTEM FOR METEOROLOGICAL SATELLITES

Rudolf A. Stampfl and William G. Stroud Washington, NASA, Nov. 1963 16 p refs

(NASA TN D-1915) OTS: $0.50

This paper describes an additional camera system for the Nimbus satellite, designed for automatic and continuous real-time picture transmission during daylight. The camera uses an electrostatic storage vidicon which is exposed for 40 milliseconds, and read-out during the succeeding 200 seconds. The 800-line resolution and the 0.25-second scanning time per line are compatible with standard 240-rpm facsimile equipment which can be used for ground display. A 5-watt transmitter broadcasts the signal in the 136 Mc space telemetry band. FM is used and this makes a large variety of standard mobile communication equipment readily adaptable. On the ground, a manually tracked or even a fixed 10-db helix antenna, with a commercially available receiver and facsimile, is the only equipment required. Author

N63-23696 Joint Publications Research Service, Washington, D.C.

STATISTICAL THEORY OF THE MICROPHYSICAL MECHANISMS OF FORMATION OF RAIN IN WARM CLOUDS

Chou Hsiu-chi (Chinese Acad. Sci.) Oct. 31, 1963 19 p refs Transl. into ENGLISH from Scientia Sinica (Peiping), v. 12, no. 8, Aug. 1963 p 1197-1211

(JPRS-21691; OTS-63-41046) OTS: $0.50

This paper gives a preliminary theoretical analysis and report on experimentation on the microphysical mechanisms of the formation of precipitation in warm clouds. The author proposes a theory of random processes of consolidation of cloud droplets, and a model of the microphysical mechanisms of formation of precipitation from warm clouds. The results show that fluctuating phenomena and turbulent coagulation caused by turbulence play an extremely important part in the formation of precipitation. Author

N63-23711 Oslo U., Blindern (Norway) Inst. of Theoretical Meteorology

A QUALITATIVE STUDY OF THE VERTICAL CIRCULATION IN FRONTAL ZONES Technical Note No. 2

M. Todsen June 25, 1963 26 p refs

(Contract AF 61(052)-525)

(AFCRL-63-732)

The transverse circulation in a real cold front caused by variations in geostrophic wind and temperature along the frontal zone has been studied. A strong, direct circulation was found in the upper parts of the front and a weak, direct one, in the lower levels. Author

N63-23772 Joint Publications Research Service, Washington, D.C.

THE INFLUENCE OF AIR HUMIDITY ON THE DEVELOPMENT OF CONVECTIVE MOTIONS IN A CLOUDLESS ATMOSPHERE

N. I. Vul'fson Nov. 5, 1963 9 p refs Transl. into ENGLISH from Doklady Akad. Nauk SSSR (Moscow), v. 151, no. 5, 1963 p 1089-1092

(JPRS-21721; OTS-63-41058) OTS: $0.50

The phenomenon of a stationary, axisymmetrical jet of warm, humid air propagated in a quiet atmosphere, and the role of air humidity on the development of convection in the atmosphere, were investigated. The convective jet, which is dependent only on the humidity of the air, was considered, and an approximate solution of the system satisfying the general energy relations was sought. Further consideration was given to the radius of the convective jet being a stepped function of the altitude.

C.L.W.

22 NAVIGATION AND GUIDANCE

Includes: autopilots; star tracking; inertial platforms; and traffic control.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; 20 Mathematics; and 29 Space Sciences.

N63-23091 Rensselaer Polytechnic Inst., Troy, N.Y.

NONLINEAR GUIDANCE SYSTEM FOR DESCENT TRAJECTORIES

C. N. Shen Repr. from AIAA J., 1963 3 p 12 refs Presented at AIAA Summer Meeting, Los Angeles, June 17-20, 1963

(NASA Grant NsG-14-59)

(AIAA Paper 63-151) AIAA: $0.50 members, $1.00 nonmembers

Two-dimensional nonlinear trajectory problems are transformed into a set of linear equations, in θ (angle) and u (reciprocal of radius), provided that specific forces can be suitably expressed nonlinearly in terms of u. For a descent trajectory, the specific angular velocity is proportional to the angle measured from the local vertical through the point of soft-landing. The problem can be solved in terms of fractional-order Bessel functions of the first kind. The hovering problem is solved in closed form for zero velocity and zero acceleration at the point of contact, where the choice of approach to the surface can be

made among angles varying from the vertical to the horizontal direction. The characteristic parameter of the solution is determinable, not only for an orbiting vehicle, but also for problems of transient objects in other orbits. Author

N63-23219 Mc Donnell Aircraft Corp., St. Louis, Mo.
THE ROLE OF SIMULATION IN THE DEVELOPMENT OF GEMINI GUIDANCE AND CONTROL
John T. Clausen, Jr. *In* AIAA 2nd Manned Space Flight Meeting [1963] p 126–133 (See N63-23201 24-01)

A simulated crew station with all the pertinent displays and controls has been constructed adjacent to the analog computer laboratory to permit real-time evaluation of guidance and control systems with man in the loop. This facility, used initially to evaluate hand controllers, displays, and attitude-control system configurations, has been expanded to include a star projector and a target projector to permit rendezvous guidance studies, and has also been fitted with an abstract presentation of the target vehicle to permit studies of the docking phase. Currently, the system is under modification to provide high fidelity projection of targets and backgrounds by means of a TV projection system. Author

N63-23221 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LUNAR LANDING AND LONG-RANGE EARTH REENTRY GUIDANCE BY APPLICATION OF PERTURBATION THEORY
Henry C. Lessing, Phillips J. Tunnell, and Robert E. Coate *In* AIAA 2nd Manned Space Flight Meeting [1963] p 140–150 refs (See N63-23201 24-01)

A guidance scheme has been investigated which has, as its basis, linear perturbation theory. An improved capability of the scheme has been achieved by the proper choice of independent variable and by appropriate weighting of the guidance gains computed on the basis of the linear theory. The capability of this guidance scheme applied to the descent-to-hover phase of lunar landing is demonstrated for two different types of nominal trajectory: a constant-thrust gravity turn maneuver, and a constant-thrust, constant-pitch-rate maneuver. It is applied to the guidance of a vehicle entering the earth's atmosphere at parabolic velocity. The guidance capability of this control scheme is evaluated for entries from abort conditions as well as for entries within the normal entry corridor; in addition, the effects upon the guidance capability of variations in lift-drag ratio and atmospheric density are investigated. Author

N63-23417 Oklahoma State U. Research Foundation, Stillwater
DIGITAL COMPUTER ROCKET TRAJECTORY ANALYSIS Scientific Report No. 2
Oscar L. Cooper May 1963 83 p
(Contract AF 19(604)-6648)
(AFCRL-63-879)

A computer program has been written for obtaining trajectory information. The program generates orthogonal components of acceleration, velocity, and position as a function of time by utilizing the longitudinal acceleration, launch angle, and wind correction data. The acceleration-time data are broken into small time increments, and the velocity and position results are composed of a continuous summation as trajectory time progresses. The computer program is applicable to single or multistage rockets. Author

N63-23685 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPARISON OF THE VON ZEIPEL AND MODIFIED HANSEN METHODS AS APPLIED TO ARTIFICIAL SATELLITES
David Fisher Washington, NASA, Nov. 1963 18 p refs
(NASA TN D-2094) OTS: $0.50

The solutions to the problem of the near-earth satellite without drag, obtained by applying the von Zeipel method and the modified Hansen method, are compared. Formulas are derived for osculating elements when the modified Hansen theory is expressed in terms of orbital true longitude. Differences in the arbitrary constants are tabulated. Transformations that relate the time element of the two theories are also given. Author

23 PHYSICS, GENERAL

Includes: acoustics; cryogenics; optics; and thermodynamics.
For astrophysics see: 05 Astronomy and Astrophysics.
For related information see: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

N63-23015 Martin Co., Baltimore, Md. RIAS Div.
GENERALIZED RECURRENCE IN DYNAMICAL SYSTEMS
Joseph Auslander July 1963 16 p 7 refs
(NASA Contract NASw-718)
(NASA CR-51997) OTS: $1.60 ph, $0.80 mf

A notion of recurrence in dynamical systems is introduced which is defined using continuous real valued functions on the phase space. The basic idea is as follows: The class of continuous real valued functions which are nonincreasing along every orbit is considered. Those orbits are singled out along which all such functions are constant. This set of orbits, which includes the periodic, recurrent, and nonwandering points, is called the generalized recurrent set. A study of the elementary properties of this set show that a single suitably chosen function reflects the "recursive" behavior of the dynamical system. By means of prolongations, an intrinsic characterization of the generalized recurrent set is given. This characterization depends on a purely topological result involving a closed quasi-order which is apparently new and may be of independent interest. The connection of the generalized recurrent set with asymptotic and absolute stability of a compact invariant set is discussed. The condition that the dynamical system be free of generalized recurrent orbits is shown to lie between parallelizability and complete instability. I.v.L.

N63-23043 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
CORRELATION PROPERTIES OF CYCLIC SEQUENCES
Robert C. Titsworth July 1, 1963 88 p 76 refs
(NASA Contract NAS7-100)
(NASA CR-51586; JPL-TR-32-388) OTS: $8.10 ph, $2.84 mf

In the unconstrained channel with additive Gaussian noise, where the optimum detector is based on correlation or matched filters, the quality of a code can be expressed as a function of the correlation values between code words. Methods are presented for determining cyclic sequences with given correlation properties. When the amount of equipment in the receiver is limited, matched filtering is no longer the optimal detection scheme. A better system is one which, by the use of a Boolean function, combines several "component" sequences to generate the transmitted signal; the

receiver consists of filters matched to each component. The logic, the number of components, the requirements of the component sequences to optimize the system, and a general method for treating Boolean logics are presented. Author

N63-23052 Gt. Brit. Ministry of Aviation, Mottingham
SOVIET ABSTRACTS: MECHANICS [SELECTED ABSTRACTS FROM REFERATIVNYI ZHURNAL: MEKHANIKA, NO. 8, 1962]
[1963] 29 p 74 refs In ENGLISH

Abstracts of papers are presented which discuss research in the following areas: (1) general mechanics; (2) hydromechanics; (3) hydrodynamics and hydraulics; (4) viscous fluid, boundary layer, heat transfer, and diffusion; and (5) elasticity and plasticity. P.V.E.

N63-23065 Jet Propulsion Lab., Calif. Inst. of Tech. Pasadena
A HIGH ORDER PERTURBATION THEORY USING RECTANGULAR COORDINATES
William Kizner N.Y., Am. Inst. of Aeron. and Astronautics [1963] 9 p 15 refs Presented at the AIAA Astrodynamics Conf., New Haven, Conn., Aug. 19-21, 1963
(NASA Contract NAS7-100)
(AIAA Paper 63-391) AIAA: $0.50 members, $1.00 nonmembers

This paper presents a method for approximating a system of nonlinear equations by a series of linear equations. The method has two parts. The first is similar to Poisson's method of developing a solution in terms of a small parameter, the difference being that Poisson used a Taylor series expansion, whereas a Rung-Kutta integration is used in this investigation. The second part involves the refinement of the solution to the extent that it has negligible error. This method has been used to solve problems in nonlinear oscillations, but there remain many problems in applying it for the derivation of general perturbation theories for the complicated equations of celestial mechanics. It is shown how to obtain analytical solutions for fixed initial conditions with the aid of a digital computer. By using rectangular coordinates, solutions are obtained for osculating elements in terms of Chebyshev polynomials. Author

N63-23070 National Bureau of Standards, Washington, D.C.
RELATION OF EMITTANCE TO OTHER OPTICAL PROPERTIES
J. C. Richmond Repr. from J. Res. Natl. Bur. Std., C, v. 67C, no. 3, July-Sept. 1963 p 217-226 10 refs
(Sponsored by NASA)

An equation was derived relating the normal spectral emittance of an optically inhomogeneous, partially transmitting coating, applied over an opaque substrate, to the thickness and optical properties of the coating, and the reflectance of the substrate at the coating-substrate interface. Author

N63-23076 California U., Berkeley
CORRELATION EFFECTS IN ATOMIC STRUCTURE USING THE RANDOM-PHASE APPROXIMATION Technical Report No. 7
P. L. Altick and A. E. Glassgold Sept. 1, 1963 46 p Submitted for Publication
(Contract Nonr-222(70); Proj. Defender)

A procedure for treating correlations in atomic structure is introduced and applied to the calculation of excitation energies, oscillator strengths, and photoionization cross sections. The method is the extension of the Hartree-Fock theory known as the random-phase approximation. Results are given for the following atoms in Column II of the periodic table: beryllium, magnesium, calcium, and strontium. These atoms all have ^1S ground states, and only excitations to ^1P states are considered. The general conclusion of the study is that the values of the oscillator strengths and photoionization cross sections are changed significantly by the correlations, while the changes in the values of the excitation energies are quite small. Author

N63-23083 Rochester U., N.Y.
ELECTRONIC SPECTRA OF POLYATOMIC MOLECULES Annual Summary Report, Oct. 1, 1962-Sept. 30, 1963
A. B. F. Duncan [1963] 10 p 3 refs
(Contract Nonr-668-(15))

A method for the study of exponential decay of fluorescence intensity in the range of about 0.01 microseconds was developed. The excitation method used is a pulsed electrodeless discharge inside the gas to be investigated. The performance of the pulsed electrodeless discharge was tested on two resolved transitions in the helium atom. The mean lifetimes were found to be independent of the pressure in the range 0.006 mm to several mm of mercury. These results agreed well with previous measurements on these transitions. The performance was tested further by study of the (0,0) transition in the second positive system of N_2. An extrapolated value of 0.0382 microsecond was obtained with an estimated overall accuracy of 20%. Measurements were made on the first positive system of N_2 for the first time. The extrapolated value of the transition, as a whole, is 9.1 microsecond. Nitric oxide was also studied over a range of pressures. There are two exponential decays observed at high pressures, one with a mean lifetime of about 5 microseconds, and the other at about 0.6 microsecond. Also, the lifetime of the fluorescence of formaldehyde was investigated. The lifetime was studied over a range of pressures and the fluorescence was studied in two spectral regions 3555 to 4255 Å and 4361 to 4675 Å. The extrapolated mean lifetime has the same value in both regions, and is 0.25 microsecond. I.v.L

N63-23089 Atomic Energy Commission, Bombay (India)
MECHANISM OF THE $Li^7(p,\alpha)He^4$ REACTION
N. Sarma, K. S. Jayaraman and C. K. Kumar 1963 21 p 8 refs
(AEET-NP-6)

The reaction $Li^7(p,\alpha)He^4$ has been investigated with a view to determine the contribution of direct interaction processes to the cross section. Excitation function at angles θ_{LAB} = 60°, 80°, 100°, and 150°, and the angular distributions at incident energies E_p = 3.0, 3.5, 4.0, 4.5, 4.88, 5.0 and 5.5 Mev, were measured. Resonant processes predominate in the reaction, and an analysis was made to determine the spins of the compound nuclear states in Be^8 at 19.9 and 22.2 Mev. Author

N63-23104 Aeronautical Research Lab., Wright-Patterson AFB, Ohio
NATURE OF THE INTERACTION BETWEEN ELECTRONS AND WELL-DEFINED SURFACES. II. INTERACTION BETWEEN A SMALL CROSS-SECTION HELICAL ELECTRON BEAM AND UNIFORM ELECTRICAL FIELDS PERPENDICULAR TO THE HELICAL AXIS
A. G. Jackson and E. L. Kern Aug. 1963 56 p 20 refs
(ARL-63-140)

Analysis of the surface electrical field by a helical electron beam tangential to the surface requires a knowledge of

the beam trajectory as well as an analysis of the beam deflection system used to instrumentally indicate this influence of the surface on the beam. This analysis has been made for a constant surface electrical field where the trajectory can be solved exactly. Author

N63-23119 Virginia U., Charlottesville. School of Engineering and Applied Science
PROJECT SQUID Semi-Annual Progress Report, Apr. 1-Sept. 30, 1963
C. Rudinger et al Oct. 1, 1963 86 p refs
(Contract Nonr 3623(00); Proj. Squid)

Results of research in the following areas are discussed: (1) fluid mechanics, (2) transport and transfer processes, (3) chemical kinetics, and (4) combustion phenomena. P.V.E.

N63-23145 Atomic Energy of Canada Ltd., Chalk River, Ontario
LONG TERM IRRADIATION OF SAP-CLAD, UO_2 FUELLED, TREFOIL BUNDLES IN THE X-7 ORGANIC COOLED LOOP
R. F. S. Robertson, H. E. Thexton, D. E. Lew, R. D. Mac Donald, and K. G. Heal May 1963 84 p 32 refs
(AECL-1782; Exp-NRX-70911) AEC of Canada: $1.50

The trefoil bundles successfully underwent an irradiation of 2400 Mwd/t U (max.). The maximum sheath temperature was 460° C in a coolant temperature of about 310° C. Surface heat fluxes were roughly 100 w/cm^2. After irradiation a film of about 80 μm thickness was found covering the sheath over fueled sections. The film was by weight 40% polymerized organic and 60% Fe_3O_4. The net effect of the film was to increase the pressure drop across the fuel by 50% and increase the sheath temperature by 60° C. The SAP (sintered aluminum product) sheath showed no effects of irradiation except for small apparent increases in diameter at two out of eighteen planes measured. The appearance of the UO_2 was similar to that of UO_2 irradiated in pressurized water loops at similar heat ratings. Author

N63-23148 Atomic Energy Commission, Bombay (India)
PREPARATION OF SODIUM IODINE-THALLIUM ACTIVATED-SCINTILLATION CRYSTALS
G. K. Bhide 1963 16 p 4 refs
(AEET-TP-3)

A procedure for growing large single crystals (up to 4 cm diam.) has been developed. Various crystal-growing containers are discussed, and a satisfactory design developed. A crystal-cutting machine (solvent-saw) for cutting blanks of various thicknesses has been described. Results of some preliminary tests on the scintillation performance are given. Author

N63-23161 Argonne National Lab., Ill.
PHYSICS DIVISION SUMMARY REPORT, ANNUAL REVIEW
Lowell M. Bollinger, June 1963 124 p 120 refs
(Contract W-31-109-eng-38)
(ANL-6720)

Progress is reported in the following areas: (1) nuclear physics, including studies of the neutron and of neutron-induced-reactions, Van de Graaff neutron and charged-particle-induced reactions, cyclotron charged-particle reactions, Mossbauer-effect experiments, atomic-beam studies, and studies of the decay of short-lived radionuclides; (2) theoretical high-energy physics; and (3) extranuclear properties of matter, including mass-spectrometric investigations and high-frequency plasma research. J.E.T.

N63-23162 Argonne National Lab., Ill.
PHYSICS DIVISION SUMMARY REPORT, JULY-AUGUST 1963
Lowell M. Bollinger [1963] 74 p refs
(Contract W-31-109-eng-38)
(ANL-6767)

Progress is reported on studies which include a tandem Van de Graaff accelerator, neutron polarization and differential cross sections, molecular-beams, unbound nuclear levels in the Kev region, perceptron for recognition of nuclear events, and general theoretical physics. J.E.T.

N63-23173 International Business Machines Corp. Yorktown Heights, N.Y.
WEAK NON LINEAR OPTICAL INTERACTIONS
Norman Braslau and Archibald W. Smith Mar. 18, 1963 26 p 5 refs
(RC-928; AROD-3318-11)

Harmonic generation and mixing of optical signals have been demonstrated in suitable crystals where a high intensity optical maser beam has induced a nonlinear polarization in the crystal. In most experiments to date, the interaction length has been so short that the intensity of the optical maser signal has not been significantly altered. From the general theory of Armstrong et al., the intensity of the waves are derived for a short interaction length for harmonic generation, mixing, and parametric amplification, making it possible to predict the intensity ratio of output signals in related experiments. Dependence of the susceptibility tensor on crystal symmetry is included. Author

N63-23193 Comitato Nazionale Per l'Energia Nucleare, Frascati (Italy)
REVIEW OF THE PROCEEDINGS OF THE ANNUAL CONGRESS OF THE NATIONAL INSTITUTE OF NUCLEAR PHYSICS, FRASCATI, (ITALY) MAY 6-9, 1963 [RACCOLTA DELLE COMUNICAZIONI PRESENTATE AL CONGRESSINO ANNUALE DELL'ISTITUTO NAZIONALE DI FISICA NUCLEARE, FRASCATI, 6-7-8-9 MAGGIO 1963]
P. Argan, G. Diambrini-Palazzi, G. Campos-Venuti, G. Franterotto, G. Matthiae, et al June 1963 264 p refs In ITALIAN, ENGLISH, and FRENCH
(LNF-63/47; VR-7)

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N63-23194 Comitato Nazionale per l'Energia Nucleare, Frascati (Italy) Lab. Nazionali

MINUTES OF THE ANNUAL MEETING OF THE NATIONAL INSTITUTE OF NUCLEAR PHYSICS, FRASCATI, MAY 6-9, 1963. COSMIC RAYS SESSION [RACCOLTA DELLE COMUNICAZIONI PRESENTATE AL CONGRESSINO ANNUALE DELL'ISTITUTO NAZIONALE DI FISICA NUCLEARE, FRASCATI, 6-7-8-9 MAGGIO 1963. SESSIONE RAGGI COSMICI]

G. Giannelli, G. Boella, G. Degli Antoni, C. Dilworth, L. Scarsi, et al June 1963 36 p 12 refs In ITALIAN (LNF-63/54; VR-8)

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N63-23195 Comitato Nazionale per l'Energia Nucleare, Frascati (Itali) Lab. Nazionali
LINEAR ACCELERATOR FOR ELECTRONS AND POSITRONS [L'ACCELERATORE LINEARE PER ELETTRONI E POSITRONI]
F. Amman and R. Andreani, July 1, 1963 46 p 11 refs In ITALIAN
(LNF-63/46; *Its* Nota Interna 206)

The characteristics of a linear accelerator that can accelerate electrons and positrons at energy levels of 400 Mev at 100 ma to 60 Mev at 500 ma are given. Trans. by P.F.E.

N63-23198 Comitato Nazionale per l'Energia Nucleare, Frascati (Italy) Lab. Nazionali
LINEAR THEORY OF ACCELERATORS. PART II: COMPUTATION OF THE COUPLING COEFFICIENTS BETWEEN THE HORIZONTAL SYNCHROTRON AND BETATRON OSCILLATIONS. EFFECTS OF THE RADIATION FLUCTUATION ON THE DIMENSION OF THE BEAMS. [TEORIA LINEARE DELLE MACCHINE ACCELERATRICI. PARTE III: CALCOLO DEI COEFFICIENTI DI ACCOPPIAMENTO TRA LE OSCILLAZIONI ORIZZONTALI DI SINCROTRONE E DI BETATRONE. INFLUENZA DELLE FLUTTUAZIONI DELL'IRRAGGIAMENTO SULLE DIMENSIONI DEL FASCIO]
G. Sacerdoti and F. Uccelli July 5, 1963 6 p In ITALIAN
(LNF-63/55; *Its* Nota Interna 210)

A method of calculating the coupling coefficients between synchrotron and betatron horizontal oscillations is given, and the effect of radiation fluctuation on the dimensions of the horizontal beam is examined. Trans. by P.F.E.

N63-23244 Paris U., Orsay (France)
THE PRESSURE DEPENDENCE OF IONIZATION BY RELATIVISTIC ELECTRONS
T. Aggson and R. Morrison *In its* Invest. of Density Effect in Solids and Gases [1962] 9 p refs (See N63-23243 24-01)

An experimental study of the pressure dependence of the specific ionization of 380 Mev electrons in hydrogen gas in order to obtain an independent test of the validity of applying radiative corrections (radiative corrections to Cerenkov radiation) to the ionization process is discussed. It is shown that the radiative corrections to the Cerenkov loss when applied to the Fermi formula (the Fermi theory of the specific energy loss) were in complete disagreement with the experimental results. P.V.E.

N63-23245 Paris U., Orsay (France)
IONIZATION BY RELATIVISTIC PARTICLES IN HELIUM HYDROGEN GAS MIXTURES
T. Aggson *In its* Invest. of Density Effect in Solids and Gases [1962] 9 p refs (See N63-23243 24-01)

Values are given for the specific ionization produced by relativistic electrons in helium–hydrogen gas mixtures. These results were obtained with an ionization chamber placed in the 150 Mev beam of the Orsay linear electron accelerator. These results are interpreted in terms of quantum mechanics. Author

N63-23248 Paris U., Orsay (France)
DIRECT ELECTRON-POSITRON PAIR PRODUCTION BY 150 MEV ELECTRONS
T. Aggson *In its* Invest. of Density Effect in Solids and Gases [1962] 26 p refs (See N63-23243 24-01)

The spectrum of positrons produced by the direct pair production at zero degree of 150 Mev electrons has been measured using an ionization chamber as the positron detector. Measurements were made with different target thicknesses and these results extrapolated to zero target thickness to give the direct production contribution. The measured number of positrons produced by bremsstrahlung gamma rays agrees well with the Bethe–Heitler formulae. Author

N63-23276 Pennsylvania State U., University Park Coll. of Chemistry and Physics
TECHNICAL REPORT, JUNE 1, 1962-SEPTEMBER 30, 1963
D. H. Rank et al [1963] 71 p 40 refs
(Contract Nonr-656(12))

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1. QUADRUPOLE SPECTRUM OF MOLECULAR HYDROGEN D. H. Rank and T. A. Wiggins 5 p 4 refs (See N63-23277 24-23)
2. COLLISION NARROWING OF SPECTRAL LINES—H_2 QUADRUPOLE SPECTRUM D. H. Rank and T. A. Wiggins 6 p 4 refs (See N63-23278 24-23)
3. EXPERIMENTAL MEASUREMENTS OF SPECTRAL LINE PROFILES D. H. Rank and T. A. Wiggins 18 p 17 refs (See N63-23279 24-23)
4. GAS PHASE COMPLEXES IN HYDROGEN CHLORIDE D. H. Rank, P. Sitaram, W. A. Glickman, and T. A. Wiggins 12 p 2 refs (See N63-23280 24-23)
5. PRESSURE INDUCED SHIFTS OF MOLECULAR BAND LINES D. H. Rank, E. F. Gardner, P. Sitaram, W. A. Glickman, and T. A. Wiggins 10 p 6 refs (See N63-23281 24-23)
6. MOLECULAR CONSTANTS OF THE GROUND STATE OF 1_2 D. H. Rank and B. S. Rao 18 p 7 refs (See N63-23282 24-23)

N63-23277 Pennsylvania State U., University Park
QUADRUPOLE SPECTRUM OF MOLECULAR HYDROGEN
D. H. Rank and T. A. Wiggins *In its* Tech. Rept., June 1, 1962–Sept. 30, 1963 5 p 4 refs (See N63-23276 24-23)
(Supported by NSF and ONR)

A "White" multiple-reflection absorption tube of a 44-meter radius of curvature of the mirrors was constructed. The tube has a diameter of 36 inches, and can be used at pressures up to 10 atmospheres. Using this tube it is easily possible, at the minimum optical path (176 meters), to observe the stronger lines of the 1 to 0 band of the quadrupole spectrum of hydrogen at a small fraction of an atmosphere pressure, and thus to measure the frequency shifts of the quadrupole

lines as a function of pressure. Pressure shifts for the S(3), S(2), S(1), S(0), and Q(1) lines in the 1 to 0 quadrupole band of H_2 are presented in graphic form. I.v.L.

N63-23278 Pennsylvania State U., University Park
COLLISION NARROWING OF SPECTRAL LINES – H_2 QUADRUPOLE SPECTRUM
D. H. Rank and T. A. Wiggins *In its* Tech. Rept., June 1, 1962–Sept. 30, 1963 6 p 4 refs (See N63-23276 24-23)
(Supported by NSF and ONR)

The S(1) line of the 1 to 0 quadrupole band at a hydrogen density of 1.5 Amagat was observed employing a resolving power of 1.85×10^5. The absorption path was 176 meters, obtained by using the 44-meter "White" multiple-reflection tube. Results are plotted in four curves. Curve A represents the Doppler contour as it would appear using instrument which has infinite resolving power; curve D shows the contour expected for the S(1) line of normal Doppler magnitude and shape which would be observed under the present experimental conditions; curve B represents the experimentally observed S(1) line profile; and curve C represents the experimentally observed line profile of the P(19) line of the 201 to 000 band of N_2O which occurs at nearly the same wavelength as the S(1) quadrupole line. The position of these curves shows that the collision narrowing predicted by Dicke does occur in the optical spectrum. I.v.L.

N63-23279 Pennsylvania State U., University Park
EXPERIMENTAL MEASUREMENTS OF SPECTRAL LINE PROFILES
D. H. Rank and T. A. Wiggins *In its* Tech. Rept., June 1, 1962–Sept. 30, 1963 18 p 17 refs (See N63-23276 24-23)

The general problem of the effect of the finite size of slits and apertures on the resolving power of high resolution instruments is reviewed. In addition, the effect of Doppler and pressure broadening on the shape of lines produced by these instruments is discussed. There is some experimental evidence that lines in the quadrupole spectrum of H_2 are sharper than the normal Doppler width. This evidence is reviewed and discussed in the light of recent theory. Author

N63-23280 Pennsylvania State U., University Park
GAS PHASE COMPLEXES IN HYDROGEN CHLORIDE
D. H. Rank, P. Sitaram, W. A. Glickman, and T. A. Wiggins *In its* Tech. Rept., June 1, 1962–Sept. 30, 1963 12 p 2 refs (See N63-23276 24-23)
(Supported by ONR and NSF)

The null gap region of the fundamental band of HCl has been studied in the case where argon and xenon are used as perturbing gases. The absorption spectrum of pure HCl gas was found to show strong evidence for dimer formation, which feature becomes strikingly evident at the lowest temperature employed. "Arrhenius" plots were made of the HCl-A, HCl-Xe, and the dimer data. The heats of formation were found to be 1.1, 1.6, and 2.14 kcal/mole, respectively, with a probable error of ±0.2 kcal/mole. The concentration of the dimer is estimated to be 1 part in 50,000 at 195° K, at a gas density of 0.36 Amagat. Author

N63-23281 Pennsylvania State U., University Park
PRESSURE INDUCED SHIFTS OF MOLECULAR BAND LINES
D. H. Rank, E. F. Gardner, P. Sitaram, W. A. Glickman, and T. A. Wiggins *In its* Tech. Rept., June 1, 1962–Sept. 30, 1963 10 p 6 refs
(Supported by ONR and NSF)

The pressure-induced shifts in the 2 to 0 band of HCl due to noble gases have been observed at 900° C for values of J up to 23. The variation of the shift with J is not predicted by current theory. The lower J data are compared with the shifts at standard atmosphere measured at 25° C. Author

N63-23282 Pennsylvania State U., University Park
MOLECULAR CONSTANTS OF THE GROUND STATE OF I_2
D. H. Rank and B. S. Rao *In its* Tech. Rept., June 1, 1962–Sept. 30, 1963 18 p 7 refs
(Supported by ONR)

The molecular constants of the ground state of the I_2 molecule have been determined from interferometric measurements for the green line resonance series, combined with ultraviolet resonance data. Values of D_e, γ_e, and β_e are calculated from theory. It is shown that the molecular constants obtained are consistent with both the green line series and ultraviolet series measurements within the precision of both sets of measurements. Author

N63-23283 European Organization for Nuclear Research, Geneva (Switzerland)
SELECTED TOPICS ON SCATTERING THEORY, PARTS II AND III
R. Hagedorn Apr. 11, 1963 184 p refs Lectures
(CERN-63-14)

CONTENTS:

1. RECAPITULATION OF QUANTUM MECHANICS, PART II R. Hagedorn p 1–72 refs (See N63-23284 23-23)
2. FORMAL THEORY OF SCATTERING, PART III R. Hagedorn p 73–179 refs (See N63-23285 23-23)

N63-23284 European Organization for Nuclear Research, Geneva (Switzerland)
RECAPITULATION OF QUANTUM MECHANICS PART II
R. Hagedorn *In its* Selected Topics on Scattering Theory Apr. 11, 1963 p 1–72 refs (See N63-23283 23-24)

A summary of quantum mechanics is presented with emphasis in the following areas: (1) notations and postulates, (2) orthogonality and completeness, (3) projection operators, (4) hermitian operators, (5) unitary operators and isometries, (6) evolution of a system in time, (7) momentum space and coordinate space in nonrelativistic quantum mechanics, (8) commuting and noncommuting observables—the uncertainty relation, and (9) symmetry in classical physics and in quantum mechanics. P.V.E.

N63-23285 European Organization for Nuclear Research, Geneva (Switzerland)
FORMAL THEORY OF SCATTERING PART III
R. Hagedorn *In its* Selected Topics on Scattering Theory Apr. 11, 1963 p 73–179 refs (See N63-23283 23-24)

The formal theory of scattering as it is applied to potential scattering is elucidated in the following areas: (1) time-independent formulation—(a) the integral equation of scattering, (b) ingoing and outgoing wave solutions, (c) scattering amplitude and cross section, (d) the formal solution of the scattering equation (Born series), (e) Green's functions and propagators, and (f) multichannel scattering (general considerations); and (2) time-dependent formalism—the Heisenberg picture, the wave operators, the S-matrix and the S'-matrix, the optical theorem, and the interaction picture. P.V.E.

N63-23343 Avco-Everett Research Lab., Everett, Mass.
POPULATION INVERSION BETWEEN BOUND AND REPULSIVE MOLECULAR ELECTRONIC STATES BY TWO-TEMPERATURE EQUILIBRIUM

D. A. Leonard, J. C. Keck and M. M. Litvak (M.I.T.) Aug. 1963 9 p 4 refs
(Contract AF 04(694)-33)
(Avco-Everett Res. Rept.-164; BSD-TDR-63-170)

The well-known ultraviolet-emission continuum of molecular hydrogen which results from transitions between the $a^3\Sigma_g^+$ and $b^3\Sigma_u^+$ electronic states is suggested as a transition for a high-power, ultraviolet, gas laser. In an electric arc, collisions of hot electrons with ground state molecules populate these two states. Steady-state inversion can be achieved by maintaining the heavy particle temperature below the electron temperature, and by maintaining the hydrogen atom concentration below the equilibrium value corresponding to the electron temperature. This suppresses the population of the lower state by reducing the rate of recombination of ground state atoms into the repulsive state. A two-temperature quasi-equilibrium model requires a temperature ratio of 1.5 for inversion. Author

N63-23352 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
TWO-CENTER INTEGRALS OVER SOLID SPHERICAL HARMONICS
Murray Geller Repr. from J. Chem. Phys., v. 39, no. 1, July 1, 1963 p 84–89 7 refs

One electron, two-center integrals (and the corresponding one-center case) are evaluated for integrals of the type

$$\int [N, L, M] a \frac{r_b^{N} P_L^{|M'|}(\cos\theta_b)}{r_b^{L'+1}} \begin{Bmatrix} \cos|M'|\phi_b \\ \sin|M'|\phi_b \end{Bmatrix} d\tau$$

arising in electromagnetic interactions. The Fourier convolution theorem method is employed and specific results are obtained for $N' = 0$ and $N' = 2$ in terms of an F function and recursion formulas. All cases up to $L' = 3$ are evaluated in terms of the F functions, and in terms of elementary functions. Author

N63-23355 European Organization for Nuclear Research, Geneva (Switzerland)
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH [EIGHTH] ANNUAL REPORT, 1962
1963 166 p refs

Activities and research conducted by CERN, the European Organization for Nuclear Research, are reviewed. Among the items discussed are the following: the proton synchrotron; the synchro-cyclotron; nuclear physics; engineering; data handling; theoretical studies; track chambers; nuclear physics apparatus; accelerator research. C.L.W.

N63-23369 Westinghouse Electric Corp., Lima, Ohio Aerospace Electrical Div.
RADIOISOTOPE THERMOELECTRIC POWER SYSTEMS
E. T. Allen Feb. 1, 1963 44 p
(D-709582)

Radioisotope-fueled thermoelectric generators for supplying electrical power for space vehicles are reviewed. The following topics are discussed: (1) thermoelectric generators utilizing convective heat transfer; (2) thermoelectric generators utilizing conductive heat transfer; (3) systems requiring decreasing amounts of power as a function of mission life; (4) systems requiring constant power as a function of mission life; (5) curium 242, polonium 210, curium 244, and plutonium 238 as alpha emitters; (6) cesium 144, cobalt 60, strontium 90, and cesium 137 as beta and gamma emitters; and (7) the design of a 60-watt thermoelectric generator. I.v.L.

N63-23373 Batelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
REVIEW OF RECENT DEVELOPMENTS: POWDER METALLURGY
V. D. Barth Oct. 18, 1963 4 p refs

Recent developments in the area of powder metallurgy are reviewed. Included in the discussion were powder compaction, powder sintering, infiltration, dispersion and fiber strengthening, and plasma spraying of powder on polished substrates. C.L.W.

N63-23374 General Electric Co., Cincinnati, Ohio Nuclear Materials and Propulsion Operation
REACTOR INSTRUMENTATION AND CONTROL Progress Report No. 79 [July 1-Aug. 31, 1963]
Sept. 30, 1963 24 p refs
(Contract AT(40-1)-2847)
(GEMP-79) OTS: $0.50

Progress reported includes the following: (1) A series of tests were run on thorium oxide and beryllium oxide at temperatures above 1649° C to determine if sensors can be applied directly across the resonant tank of a vacuum tube oscillator in such a way that the resistance change would not affect a significant change in the frequency. (2) Several improvements were made on the integrated capacitance temperature indicating system. A new probe was made for use with the system. The stability of the oscillator was improved by securing all the leads and by cementing the turns on the oscillator coil. (3) The testing of fission counter assemblies to a temperature of 816° C was concluded. The data indicate that it is feasible to satisfactorily operate this type of neutron sensor to a temperature of 816° C. (4) The testing of the MgO-insulated coaxial cables at temperatures of 649° C was satisfactorily concluded. (5) A split collector was made and tested at 538° C. (6) Two cylindrical gridded a.c. ionization chambers and four charged-fragment detectors were tested under X-ray and thermal neutron flux. (7) The operation of a compensated a.c. ionization chamber was investigated. I.v.L.

N63-23380 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
METHOD OF ACCELERATING AN ELECTRON IN AN INDUCTION ACCELERATOR
Bohumir Susta Apr. 10, 1963 6 p Transl. into ENGLISH from Czech. Patent 97206, (Class 21g, 36, Apr. 15, 1960), Nov. 1, 1960 1 p
(FTD-TT-62-1787/1+2)

The induction accelerator is characterized by the fact that in the space where the electrons are accelerated, rings made from electrically conducting material are used. This material is cooled to a temperature at which a superconductive state is attained, allowing the generation of very high currents, which are maintained in a closed area for a very long time. The acceleration ring consists of an insulated carrier part on which a layer of lead-bismuth alloy is applied, and tungsten discs placed at suitable positions. Upon falling on one of these disks, accelerated electrons originate gamma radiation. The method used in this accelerator allows: (1) the possibility of accelerating within one acceleration period a large number of electrons because the electron density in the beam is not limited by the space charge, and (2) the possibility of functioning as a double-action accelerator. C.L.W.

N63-23398 Laboratoire de Physique Theorique et Hautes Energies (France)
POLARIZATION EFFECTS IN ELASTIC LEPTON-PROTON ELECTROMAGNETIC SCATTERING

F. Guerin and C. A. Piketty Sept. 1963 20 p 16 refs

Polarization effects in lepton-proton elastic scattering are calculated using an isobaric model. The maximum effects stay around −0.5% for incident lepton laboratory momenta of the order of 1000 Mev/C and for large momentum transfer.

Author

N63-23399 National Bureau of Standards, Washington, D.C.
BIBLIOGRAPHY ON ATOMIC TRANSITION PROBABILITIES
June 1963 16 p refs
(NBS Monograph 50)

N63-23752 Duke U., Durham, N.C.
ON THE REPRESENTATIONS OF THE SEMI-SIMPLE LIE GROUPS II
G. E. Baird and L. C. Biedenharn Aug. 3, 1963 53 p refs
(Partially supported by Army Res. Office and NSF)

The explicit determination of the matrices of the generators of the unitary groups is carried out and discussed in two alternative treatments: (1) by purely algebraic infinitesimal methods, and (2) by Young pattern techniques employing the Schwinger–Bargmann boson operator methods. The implication of this result for a tableau calculus is discussed, and a determination of the $[\lambda] \times [1]$ Wigner coefficient for all U_n is indicated. Author

N63-23403 Douglas Aircraft Co., Santa Monica, Calif. Missile and Space Systems Div.
CALCULATIONS OF THE TRANSITION MOMENTS AND THE OSCILLATOR STRENGTHS OF THE ABSORPTION SPECTRA OF SOME CONJUGATED MOLECULES WITH THEIR POSITIVE AND NEGATIVE IONS IN THE FREE ELECTRON MODEL I: NAPHTHALENE MOLECULE
S. G. Elkomoss Aug. 1963 21 p refs Presented at the Symp. on Molecular Structure and Spectroscopy, Columbus, Ohio, June 10, 1963 Submitted for Publication
(Engineering Paper No. 1662)

The orbital energies and the transition moments for the absorption spectra of naphthalene with its positive and negative ions have been calculated in the free electron model. Orbital energy calculations for anthracene are also presented, and the positions of absorption bands are predicted for the positive and negative ions of this molecule. The calculations are in good agreement with experiment. Author

N63-23429 New Hampshire U., Durham
INVESTIGATIONS IN THEORETICAL PHYSICS Progress Report No. 1, Feb. 1-Sept. 30, 1963
Lyman Mower Oct. 1963 3 p 4 refs
(Grant DA-ARO(D)-31-124-G422)

Research effort in (1) the modification of the quantum mechanical Liouville equation and (2) the analysis of level shifts is reported. An exact expression for the equation of motion for the density matrix of a system of interest in interaction with a large reservoir has been formulated using Liouville operators. The formalism leads naturally to a general expression for the line shape. The Wigner–Weisskopf theory of the broadening of spectral lines has been directly extended to the space of density operators within perturbation-theory limits using this formalism. The application of this formalism to further studies of line shape when perturbation theory is not valid is being analyzed. In the second study, the shift in energy levels of isolated atoms polarized by spin exchange collisions with optically polarized samples is being investigated. M.P.G.

N63-23460 Istituto Superiore di Sanita, Rome (Italy)
THE SEMINAR AT THE PHYSICS LABORATORY DURING THE PERIOD JANUARY–APRIL 1963 PART I [IL SEMINARIO DEI LABORATORI DI FISICA NEL QUADRIMESTRE GENNAIO–APRILE 1963 PARTE I]
May 10, 1963 60 p refs In ITALIAN and ENGLISH For Part II see N63-23465 24-23

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11. THE INTERNATIONAL CONFERENCE ON PHYSICS OF HIGH ENERGIES AND NUCLEAR STRUCTURE (CERN, FEB. 25-MAR. 2, 1963) G. Matthiae p 50–54 (See N63-23464 24-23)

N63-23461 Rome U., (Italy) Istituto di Fisica
PRODUCTION OF RESONANT STATES IN THE SCATTERING OF $K^- - p$ [PRODUZIONE DI STATI RISONANTI NELL'URTO $K^- - p$]
G. C. Moneti *In* Ist. Sup. di Sanita, Rome The Seminar at the Physics Lab. during the Period Jan.–Apr. 1963, Part I p 1–8 refs In ITALIAN (See N63-23460 24-23)

The resonant states in the scattering of $K^- - p$ are studied by the use of photography of a separated beam of K^- at 2.24 Gev in a hydrogen medium. Of 75,000 photographs, 25,000 were taken with K^- at 2.5 Gev. Average intensity per photograph was 7 K^- with a 5 to 10% π meson contamination and a 5 to 10% μ meson contamination. A second group of pictures, over 100,000, were taken at higher intensity. Trans. by P.F.E.

N63-23462 Rome U., (Italy) Instituto di Fisica
THE PERIPHERAL MODEL IN NUCLEON-NUCLEON COLLISIONS [IL MODELLO PERIFERICO NELLE COLLISIONI NUCLEONE-NUCLEONE]
E. Ferrari *In* Ist. Superiore di Sanita, Rome The Seminar at the Physics Lab. during the Period Jan.–Apr. 1963, Part I p 13–21 In ITALIAN (See N63-23460 24-23)

Anelastic nucleon–nucleon collisions at energies greater than 1 Gev, which are typical examples of processes in which the distribution of the reaction products are considerably different from theoretical predictions, are studied. Particularly, in such reactions, it is observed in the center of the mass that there is a tendency of the initial particles to conserve the modulus and direction which the impulse had before the collision, and at a small energy loss. A mechanism of interaction

which can qualitatively account for this phenomenon is the so-called "peripheral model" in which the interaction between the two initial nucleons is represented by the change of a single pion. An example of a peripheral diagram in producing a single pion in the nucleon–nucleon scattering reaction is given. Trans. by P.F.E.

N63-23463 Texas U., Austin Inst. of Physics
DIRECT REACTIONS
B. B. Kinsey *In* Ist. Superiore de Santita, Rome The Seminar at the Physics Lab. during the Period Jan.–Apr. 1963, Part I p 47–50 (See N63-23460 24-23)

Knowledge of the nature of nuclear reactions, particularly direct reactions, is very incomplete. Reactions and measurements of the energy spectrum of inelastically scattered neutrons and protons always result in a residue of higher energy particles which cannot be accounted for by the compound nucleus hypothesis, and the residue is always directed forward. A direct reaction is defined as a reaction in which the primary collision products presumably leave the product nucleus in its ground state or at least in a state of low excitation. P.F.E.

N63-23464 Istituto Superiore di Sanita, Rome (Italy)
THE INTERNATIONAL CONFERENCE ON PHYSICS OF HIGH ENERGIES AND NUCLEAR STRUCTURE (CERN, FEBRUARY 25-MARCH 2, 1963) [LA CONFERENZA INTERNAZIONALE SULLA FISICA DELLE ALTE ENERGIE E LA STRUTTURA NUCLEARE (CERN 25 FEBRAIO-2 MARZO 1963)]
G. Matthiae *In its* The Seminar at the Physics Lab. during the Period Jan.–Apr. 1963, Part I p 50–54 In ITALIAN (See N63-23460 24-23)

The conference was devoted to problems of nuclear physics which could be studied by using high-energy accelerators. Particular emphasis was given to the study of hypernuclei, that is those nuclei which have been observed in nuclear emulsion following an interaction of an odd particle with a nucleus. Disintegration of hypernuclei resulted in an energy change and made it possible to determine the intensity of Λ-nucleon reaction. The reactions (p, 2p) and (α, 2α) and the study of the fragmentation of two nuclei produced by high-energy particles were also highlighted. P.F.E.

N63-23465 Istituto Superiore di Sanita, Rome (Italy)
THE SEMINAR AT THE PHYSICS LABORATORY DURING THE PERIOD JANUARY-APRIL 1963 PART II [IL SEMINARIO DEI LABORATORI DI FISICA NEL QUADRIMESTRE GENNAIO-APRILE 1963 PARTE II]
May 10, 1963 57 p In ITALIAN and ENGLISH For Part I see N63-23460 24-23
(ISS 63-30)

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21. THE ALFVEN-KLEIN HYPOTHESIS ON THE PRESENCE OF ANTIMATTER IN THE UNIVERSE A. Reale p 99–100
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23. TOBACCO VIRUS AND CODING PROBLEM H. Fraenkel-Conrat (Calif. U.) p 103–104

N63-23466 Centre d'Etudes Nucleaires, Saclay (France)
POSSIBILITY OF AN EXPERIMENTAL STUDY ON THE INTERACTION OF π-π [POSSIBLITA DI UNO STUDIO SPERIMENTALE DELL'INTERAZIONE π-π]
F. Selleri *In* Ist. Superiore di Sanita, Rome The Seminar at the Physics Lab. during the Period Jan.–Apr. 1963 Part II p 55–65 In ITALIAN (See N63-23465 24-23)

The determination of π-π scattering is of great importance. Unfortunately a direct experimental study is not possible now, nor does it seem possible in the near future. An indirect method of calculating the reaction using Chew and Low's work of 1959 as a point of departure is suggested. Trans. by P.F.E.

N63-23468 European Organization for Nuclear Research, Geneva (Switzerland)
PION CAPTURE FOR SHELL MODEL INVESTIGATIONS
T. Ericson *In* Ist. Superiore di Sanita, Rome The Seminar at the Physics Lab. during the Period Jan.–Apr. 1963 Part II p 88–91 (See N63-23465 24-23)

Quasi-elastic nucleon scattering in complex nuclei is suggested for the investigation of two-hole excitation because of its success in the study of one-hole excitation.
Trans. by P.F.E.

N63-23495 Lockheed Missiles and Space Co., Sunnyvale, Calif.
SHOCK HUGONIOTS FOR HYDROGEN-ARGON MIXTURES
Technical Report: Physics
Wayland C. Marlow III Apr. 1963 23 p 11 refs
(RR-463-8; LMSC-6-90-63-39)

The shock Hugoniots are calculated for a 1/3 hydrogen-2/3 argon gaseous mixture for initial pressures ranging from 50 to 6 mm Hg at an initial temperature of 297° K. The initial unshocked gaseous mixture is described, and the shock Hugoniots behind the incident shock are calculated for the following temperature regimes: (1) ideal gas, (2) vibrational, (3) dissociation, and (4) ionization. Numerical results are given for the first three regimes, and the basic equations for numerical calculation are given for the fourth regime. M.P.G.

N63-23497 Westinghouse Corp., Pittsburgh, Pa. Westinghouse Research Labs.
PHOTOELASTIC ANALYSIS OF REINFORCED OPENINGS IN CYLINDRICAL, SPHERICAL, AND TORO-SPHERICAL SHELLS SUBJECTED TO INTERNAL PRESSURE
M. M. Leven Feb. 11, 1963 53 p
(Contract NOBs-78182)
(Res. Rept. 63-917-514-R1)

Stress-distribution tests on reinforced openings in spherical and cylindrical vessels and in a toro-spherical head were performed. All of the reinforced openings were machined integrally with the vessels. Reinforced opening parameters and maximum stresses, as well as the stress patterns and distributions, are presented. R.T.K.

N63-23499 Lockheed Missiles and Space Co., Sunnyvale, Calif.
OCCUPATION NUMBERS OF THE EXCITED STATES OF ATOMIC HYDROGEN Technical Report: Physics
Wayland C. Marlow III Aug. 1963 21 p 11 refs
(RR-463-9; LMSC-6-90-63-24)

A calculation of the occupation numbers of the excited states of atomic hydrogen is presented. First, the free energy of the medium, in terms of the numbers of the various species which are present, is determined by following Fermi principles but including first-order effects due to ionization. Then the population of the various states is found by forming the condition for equilibrium (which requires that the free energy be a minimum) under the restraints that the mass of the system be fixed and that the net charge vanish. The method of Lagrangian multipliers is applied to this minimal problem to derive the occupation numbers of the various excited states. M.P.G.

N63-23502 General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
CATALYSIS OF OXYGEN ATOM RECOMBINATION
B. F. Myers, F. M. Graber, and J. J. Brainard Arnold Eng. Develop. Center, Oct. 1963 35 p refs
(Contract AF 40(600)-989)
(AEDC-TDR-63-239)

A search has been made for materials which could act as effective catalysts for oxygen atom recombination. Ten gases have been examined for this effect in the temperature range 297° K to 753° K over a pressure interval of 0.2 mm to 2.0 mm Hg. No effective catalysts were discovered among the following gases: boron trifluoride, carbon dioxide, carbon tetrafluoride, sulfur hexafluoride, carbonyl sulfide, carbon disulfide, carbon monoxide, monomethylamine, stannic chloride, and sulfur dioxide. A few solids were tested and, of these, graphite exhibited interesting catalytic activity. An indication of its possible effectiveness was given by calculating the ratio of the rate loss of oxygen atoms in its presence to that in its absence. The upper limit to this ratio was found to be 2500 at 10^{-4} atm and 300° K. Author

N63-23508 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
GENERAL SOLUTION OF THE EQUATIONS OF EQUILIBRIUM FOR ANISOTROPIC AND ISOTROPIC BODIES
E. N. Baida Aug. 30, 1963 22 p refs Transl. into ENGLISH from Izvest. Vyssh. Ucheb. Zaved. Stroj. i Arkhitekt., no. 6, 1958 p 17-27
(RSIC-48)

A method of solving equations of elastic equilibrium for an anisotropic body during displacements is presented. By solving Lamé equations, the correctness of the method is verified and leads to a solution based on one biharmonic and one harmonic function. The relationship of the obtained solution with the solutions of L. S. Leibenzon and P. F. Papkovich is shown. The possibility of representing a general solution by means of one function, satisfying the differential equation of the fourth order, and by one satisfying the differential equation of a second order, is illustrated for an isotropic body. Starting with Lamé's system of differential equations, and by modifying their general solutions, the Bussineck-Galerkin and Grodskii-Papkovich solution are derived. R.T.K.

N63-23512 Washington, U., Seattle
ON THE THEORY OF PHOTOVISCOELASTICITY
Ellis Harold Dill Jan. 1963 27 p 7 refs
(Rept. 63-1)

The general problem of photoviscoelasticity cannot be solved by a simple extension of the experimental and interpretive methods which are used in classical photoelasticity. For viscoelastic materials, a complete time history of isochromatics and isoclinics must be recorded. The stress state is then determined by an integral operation. Author

N63-23542 Carnegie Institution of Washington, D.C.
LABORATORY PHYSICS
L. Brown, N. P. Heydenburg, H. Rudin, and G. M. Temmer *In its* Annual Rept. of the Director of the Dept. of Terrest. Magnetism, 1961-1962 Dec. 10, 1962 p 242-244 refs (See N63-23539 24-01)

Research in nuclear physics covers the following areas: (1) the installation and use of an atomic beam apparatus to be used with the pressurized Van de Graaff generator to produce polarized deuterons by the atomic beam method; (2) excitation reactions studies through use of the polarized ion source; this included $Li^7(p,\alpha)\alpha$, $Li^6(d,\alpha)\alpha$, $Be^9(p,\alpha)Li^6$, $F^{19}(p,\alpha)O^{16}$, $Na^{23}(p,\alpha)Ne^{20}$, $Al^{27}(p,\alpha)Mg^{24}$, and $N^{15}(p,\alpha)C^{12}$. P.V.E.

N63-23562 General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
ELECTRON TIME-OF-FLIGHT VELOCITY SELECTOR Annual Report and Technical Summary [Oct. 1, 1962-Sept. 30, 1963]
G. C. Baldwin Oct. 1963 46 p 11 refs
(Contract Nonr-3942(00))

An electron time-of-flight velocity selector is described. A single, magnetically shielded, cylindrical drift chamber is mounted within a vacuum enclosure. Small diametrically disposed openings admit an electron emitter and a light beam to excite photoemission. One end of the drift tube is terminated by a plane grid. An electron detector beyond the grid is biased positively to establish an accelerating field which imparts energy sufficient for detection of the electrons. Preliminary results obtained by the use of this selector have confirmed its principle. I.v.L.

N63-23570 Argonne National Lab., Ill.
THE BIOLOGICAL IRRADIATION FACILITY ("JANUS" REACTOR). DESIGN MANUAL
W. H. Mc Corkle, A. W. Pierce, and D. C. Thompson June 1963 170 p 4 refs
(Contract W-31-109-eng-38)
(ANL-6745)

The "Janus" reactor was designed for use in research on the biological and genetic effects of radiations arising from the fission process, particularly those radiations encountered by personnel engaged in the use of nuclear reactors. This manual describes: the general design considerations; the basic design parameters; the reactor facility; the reactor components and equipment; nuclear monitoring instruments, employing appropriate sensing elements and electronic circuitry; instrumentation used with the primary and secondary coolants and with the external system for heat dissipation; regulating rod-position indicators; a shim-safety rod-position indicator; a weathermaster unit; a closed-loop TV system; a TV eye; and a shutter timer. I.v.L.

N63-23577 Rensselaer Polytechnic Inst., Troy, N.Y.
ELASTIC COMPLIANCES OF CYLINDRICALLY AEOLOTROPIC PLATES
W. H. Hoppmann, II and I. A. Minkarah Sept. 1963 27 p 5 refs
(Contract DA-30-069-AMC-195(R))

An experimental method for the determination of the elastic compliances of cylindrically aeolotropic plates has been developed. It consists in subjecting a simply supported circular plate to a concentrated transverse load and measuring deflections at appropriate locations. Substitution of the measured deflections into the solution of the differential equation of flexure of the plate provides a set of simultaneous algebraic equations for the determination of the compliances. As an illustration of the method, the equivalent elastic compliances for a circular aluminum plate reinforced with circular stiffeners of the same material were determined. The results are presented in the form of curves and tables. Author

N63-23603 Naval Research Lab., Washington, D.C.
DIRECT ENERGY CONVERSION LITERATURE ABSTRACTS
July 1963 183 p 1077 refs

This is a collection of references from various sources covering the current literature on thermoelectricity, thermionic emission, photoelectric processes, magnetohydrodynamics, electrochemical processes, energy storage, and energy sources. Author

N63-23614 Rensselaer Polytechnic Inst., Troy, N.Y.
FLEXURAL VIBRATIONS OF CYLINDRICALLY AEOLOTROPIC CIRCULAR PLATES
I. A. Minkarah and W. H. Hoppmann, II Oct. 1963 21 p refs
(Contract DA-30-069-AMC-195(R))

Equations for the determination of the frequencies of flexural vibration and corresponding modal shapes for cylindrically aeolotropic circular plates are presented. A considerable analysis has been made of the case of symmetric vibrations, and results are tabulated. The theory is exemplified by an analysis of the vibration of a circular plate with circular stiffeners for which the effective elastic compliances had been determined previously. Some discussion is given for the important problem of approximating plates with attached stiffeners by equivalent, homogeneous, uniformly-thick aeolotropic plates. Author

N63-23625 Air Force Systems Command, Wright-Patterson AFB, Ohio Electronic Research Branch
DETERMINATION OF THE SECOND DERIVATIVE OF LANGMUIR PROBE CHARACTERISTICS BY AN INTERMODULATION METHOD
E. M. Friar, Jr. [1963] 7 p refs Presented at the Ann. Phys. Electron. Conf., Cambridge, Mass., Mar. 1963

A device is described which determines the second derivative of a probe IV curve by measuring the intermodulation of two sine waves caused by the nonlinearity of the IV characteristics. It can be used wherever plasma conditions permit the use of Druyvesteyn's second-derivative analysis. When this device is in the "operative" position, the current at frequency $(\omega_c - \omega)$ is sampled, amplified, and plotted. In "calibrate," a $(\omega_c - \omega)$ signal from the reference generator replaces the oscillators, and a precision resistor replaces the probe. By measuring the v_o (peak value) the plotter can be calibrated directly in terms of I, even though the overall system gain is unknown. Although two oscillators are required, the system is simpler than previous ones and also provides quantitative information. The true shape of the distribution function can be found. Deviations from the Maxwellian are quickly revealed. (A semilog plot of the second derivative function of a Maxwellian is a straight line.) I.v.L.

N63-23636 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
WIDE-ANGLE, WIDE-APERTURE OBJECTIVE, THE "KINO-RUSSAR 7"
M. I. Kuz'mina and M. M. Rusinov Dec. 12, 1962 4 p Transl. into ENGLISH from Russian Patent 141655 (689078/26) 1960 p 1-2
(FTD-TT-62-1509/1+2)

A wide-angle, wide-aperture objective with a focal length of 22.5 mm, a relative aperture of 1:3.5, and an angle of the field of vision of 108° was designed. In order to obtain the minimum possible dimensions of the lenses for a given field of vision and simplicity in manufacturing, an exterior component is used. This component is a telescopic system with angular magnification of 0.5 and consists of two negative meniscuses with spherical surfaces. The internal component is a five-lens objective of the Gauss type. R.T.K.

N63-23673 Los Alamos Scientific Lab., N. Mex.
IMPLICIT RADIATION DIFFUSION
Robert N. Thorn and Burton Wendroff Oct. 21, 1963 28 p refs
(Contract W-7405-eng-36)
(LAMS-2960) OTS: $0.50

It is shown that a considerable saving in computing time can be obtained by the use of unconditionally stable, or implicit, finite difference approximations to the radiation diffusion equation. The effectiveness of implicit difference equations depends on the existence of rapidly convergent iteration procedures for solving the nonlinear system of equations which determines the temperature distribution at each time step. It is shown by application to some typical situations that Newton's method provides such a procedure. The flux is defined as an integral whose derivative involves only values of the opacity, and tabulated energy can be replaced by a continuously differentiable function of temperature by the use of the spline fit. The same holds true with interfaces and various boundary conditions. Author

N63-23674 Illinois U., Urbana
FORMULATION AND EVALUATION OF APPROXIMATE ANALOGIES FOR TRANSIENT TEMPERATURE DEPENDENT LINEAR VISCOELASTIC MEDIA
Harry H. Hilton and James R. Clements Aug. 1963 34 p refs
(AAE 63-2)

Approximate Laplace transform analogies are derived for linear viscoelastic media exposed to time and space dependent temperatures, and obeying the thermorheologically simple and/or time-temperature superposition principles. The accuracy of these analogies as well as of the previously developed approximate analogies for viscoelastic differential stress-strain laws is evaluated by application to three specific problems. Exact and approximate solutions are obtained for uniaxial tension and simple bending of a material whose deviatoric and dilatational responses are represented by a temperature-dependent Maxwell body and elastic model, respectively. The thermal loading of an infinite slab with thermorheologically simple properties is also analyzed. Author

N63-23676 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

EFFECTS OF REGENERATIVE AND RADIATION COOLING ON PERFORMANCE OF ELECTROTHERMAL THRUSTORS

John W. Schaefer and John R. Jack Washington, NASA, Nov. 1963 13 p 3 refs

(NASA TN D-1738) OTS: $0.50

The effects of regenerative and radiation cooling on thrustor performance, as judged by the specific impulse, are presented for a frozen flow with a constant input power and propellant flow rate. In general, the performance gains to be achieved by regenerative cooling are strongly dependent on such operating parameters as gas enthalpy, wall temperature, and amount of regenerative cooling. When the frozen-flow efficiency decreases with increasing gas enthalpy, increased regenerative cooling results in a small gain or a loss in performance, depending on the wall temperature. When the frozen-flow efficiency increases with increased enthalpy, however, significant performance gains due to regenerative cooling can be anticipated, regardless of the assumed wall temperature. Author

N63-23680 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

ANGULAR DISTRIBUTION OF EMITTED AND REFLECTED RADIANT ENERGY FROM DIFFUSE GRAY ASYMMETRIC GROOVES

Morris Perlmutter and John R. Howell Washington, NASA, Oct. 1963 45 p refs

(NASA TN D-1987) OTS: $1.25

The directional emissivity and directional reflectivity of an infinitely long, isothermal, asymmetric groove with diffusely emitting and reflecting gray walls are analyzed, and numerical results are given. The directional emissivity is presented as a function of the groove parameters and material emissivity, while the directional reflectivity is presented as a function of these parameters and the angle of incident radiation. The directional reflectivity was found to be greatest at angles close to the angle of the incident beam, in sharp contrast to the commonly assumed diffuse or specular modes of reflection. The directional emissivity was greatest close to the angle bisecting the groove. The results thus indicate that the surface structure has a strong effect on the radiative properties. Author

N63-23683 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

A NUMERICAL ANALYSIS OF DIRECT NUCLEAR ELECTRO-GENERATOR CELLS THAT USE CERIUM 144 BETA-EMITTING RADIOISOTOPE SOURCES

Allen J. Cohen Washington, NASA, Nov. 1963 58 p refs

(NASA TN D-2070) OTS: $1.50

An analysis of a radioisotope electric cell that uses the beta emitter, cerium 144, was undertaken. The analysis, which relies on formats set forth for fission electric cells, takes into account the pertinent physical constraints in a more accurate manner than has been done previously. Results from the analysis are presented in tables and as representative plots. Comparisons between accurate and approximate solutions are also included. Author

N63-23691 Lockheed Missiles and Space Co., Sunnyvale, Calif.

THEORY AND APPLICATION OF RADIATION FORCES

Lyle E. Wiggins Sept. 25, 1963 268 p 18 refs

(Contract AF 04(647)-787)

(LMSC-A384055)

This report presents a review of the theoretical basis of radiation forces. Employing the notion of electromagnetic momentum, a general expression for the radiation force on an element of anisotropic convex surface area on a body of arbitrary shape is obtained. By assuming the surface is isotropic, this general expression is simplified and applied to several simple geometric body shapes for which radiation force and moment coefficient expressions are obtained. A digital computer program was developed to evaluate these expressions, and the effects of reflection mode and reflectance are studied. Tables of certain functions necessary for the calculation of radiation forces and moments are presented for the case of either specular or diffuse reflection and constant reflectance. The special cases of thermal radiation and absorbed incident radiation which is reemitted are considered. Author

N63-23692 General Electric Co., Schenectady, N.Y.

EXPLORATORY ENERGY CONVERSION STUDY OF PHOTON THERMIONICS [Final Report]

M. D. Gibbons Wright-Patterson AFB, Ohio, AF Aero-Propulsion Lab., July 1963 48 p refs

(Contract AF 33(657)-9202)

(ASD-TDR-63-707)

This study was initiated to determine whether photon processes could increase thermionic converter performance. A converter designed specifically for use on this program was fabricated with a wire grid collector placed in grooves of a sapphire window and located opposite a planar emitter. This converter was tested with five different radiation sources, each with a particular spectral characteristic. The only source that produced an effect on the converter operation was a 200-watt-second xenon flash lamp. This lamp produced a 20-percent increase in the short-circuit current with the converter operating in the ion-rich region, and at least an order of magnitude change in short-circuit current in the electron-rich region. In this latter region, the current was still somewhat space charge limited even with the radiation. One-third of the observed effect was due to 0.8 watt cm^{-2} of the first resonance radiation, while one-quarter of the observed effect was due to one watt cm^{-2} of near ultra-violet. Author

N63-23693 General Electric Co., Syracuse, N.Y. Electronics Lab.

EXPLORATION STATIC ENERGY CONVERSION – MULTILAYER THERMIONICS [Final Report, July 1, 1962-May 1, 1963]

P. R. Emtage and W. J. van der Grinten Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Aug. 1963 113 p refs

(Contract AF 33(657)-9204)

(ASD-TDR-63-723)

A new static heat-to-electricity conversion principle has been studied and is described. The new principle involves an attempt to duplicate the performance of a vacuum tube thermionic converter, in the solid state and at a lower temperature. The basic arrangement is a multiple thin film structure, consisting of alternate layers of semiconductors and metals, arranged perpendicular to the direction of heat flow. Transverse and longitudinal Seebeck voltage measurements have been made on monolayers and multilayers of germanium films. Depending on the electrode material used, transverse p-type Seebeck voltages as high as 30 μv across 4,000 Å of sputtered germanium have been observed, using a heat-pulse-type technique. Thermoelectric anisotropies are very pronounced. Temperature dependencies in the vicinity of room temperature were found to be relatively small. Author

N63-23700 Brown U., Providence, R.I.
VARIATIONAL PRINCIPLES FOR LINEAR ELASTODYNAMICS Technical Report No. 22
M. E. Gurtin Sept. 1963 34 p 10 refs
(Contract Nonr-562(25))

Variational principles are established which fully characterize the solution of the mixed boundary-value problem for a general (inhomogeneous and anisotropic) linear elastic solid. R.T.K.

N63-23704 Massachusetts Inst. of Tech., Cambridge Hydrodynamics Lab.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF WAVE ENERGY DISSIPATORS COMPOSED OF WIRE MESH SCREENS
Y. Goda and A. T. Ippen Aug. 1963 75 p 19 refs
(Contract Nonr-1841(59))
(R63-44)

Wave energy dissipators composed of vertical wire-mesh screens aligned normal to the direction of wave propagation were analyzed theoretically and tested. The transmission coefficients of the wave energy dissipators were expressed as a function of number and size of screens and of incident wave steepness. Three energy dissipators made of galvanized wire mesh screens with four mesh per inch, and one dissipator made of bronze wire mesh screens with sixteen mesh per inch were tested for deep water waves. The experimental transmission coefficients which varied from 0.14 to 0.92 were in good agreement with the analytical values. The reflection coefficient of the wave energy dissipator when placed in a standing wave system was empirically expressed as the 5/2 power of the transmission coefficient. Author

N63-23706 California U., Berkeley Lawrence Radiation Lab.
PION-PION RESONANCES FROM PION-NUCLEON INELASTIC INTERACTIONS
Zaven G. T. Guiragossian (Ph.D. Thesis – May 15, 1962) Aug. 13, 1963 54 p 30 refs
(Contract W-7405-eng-48)
(UCRL-10731) OTS: $1.25

The 72-inch hydrogen bubble chamber with a 3.3-bev/c π^- beam was used to study the pion-pion system in π-p interactions. Events were analyzed by means of the FOG-CLOUDY-FAIR data reduction system: 532 events were identified to be (1) $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ ($\pi^-\pi^+$ system, T = 0,1,2), and 365 events to be (2) $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ ($\pi^-\pi^0$ system, T = 1,2). If high-energy interactions are dominated by a Regge pole having the quantum numbers of the vacuum (T = 0, J parity even) then such a pole should manifest itself in the physical region as a $\pi\pi$ resonance in the T = 0, J = 2 state, at a $\pi\pi$ barycentric energy of ω = 1000 to 1300 Mev. The distribution in ω for reactions (1) and (2) is strongly peaked at 775 Mev, which accounts for the T = 1 ρ^0 and ρ^- mesons, respectively. Moreover, reaction (1) has a second peak at a central value of 1250 Mev. The possibility that this peak is the T = 0, J = 2 $\pi\pi$ resonance is discussed. Author

N63-23712 California U., Berkeley Lawrence Radiation Lab.
TRANSITION PATHS OF μ^-MESONS CAPTURED IN SOLID LITHIUM
Coates R. Johnson Aug. 1963 108 p 16 refs
(Contract W-7405-eng-48)
(UCRL-10965) OTS: $2.25

This paper investigates the cascade down to the ground state of a μ^- meson captured by an atom of solid lithium. The cascade takes place predominately through three processes. These are radiation transitions, Auger transitions involving the K shell electrons of the mesonic atom, and Auger transitions involving the band electrons of the solid. It is assumed that the meson is captured in a state of high principal quantum number (n ~ 15). It is found, independent of the number of K shell electrons remaining in the mesonic atom that the principal decay paths follow, at least approximately, and if the meson is captured in a high ℓ state, the route $\Delta n = \Delta\ell = -1$. For mesons captured in low ℓ states there is a tendency for the main paths to pass through states of higher ℓ than that given by $\Delta n = -1, \Delta\ell = -1$. Author

N63-23717 Army Missile Command Huntsville, Ala.
ON LATTICE VIBRATION OF A BODY-CENTERED CUBIC LATTICE WITH TWO KINDS OF ATOMS
Y. Shibuya, Y. Fukuda, and T. Fukuroi Oct. 9, 1963 12 p refs Transl. into ENGLISH by JPRS from Busseiron Kenkyu (Japan) v. 37, 1951 p 160–167
(RSIC-79)

Using a three-dimensional treatment, a study of lattice vibration of β-brass alloys with an arbitrary degree of long-range correlation is discussed. The mass ratio of the two atoms seems to influence considerably the variation of $\nu - \sigma$ curves due to changes in the degree of correlation. In the case of β-brass, this value is nearly 1(~1.03) so that the variation is not very pronounced. When similar calculations are applied to Cu_3Au, a large difference seems to occur. P.V.E.

N63-23726 Air Force Systems Command Wright-Patterson AFB, Ohio Foreign Tech. Div.
PREVENTION OF RADIATION FATALITY BY ADMINISTRATION OF SELENIUM SALTS AFTER X-RAY IRRADIATION
Z. Maria Hollo and Sztojcso Zlatarov Dec. 6, 1962 10 p refs Transl. into ENGLISH from Borgyogyaszati Venerol. Szemle (Budapest) no. 5, 1960 p 204–207
(FTD-TT-62-1227/1+3+4)

The investigation showed that lethal radiation effects were caused by an "unnecessarily active" sulfhydryl group which was formed as a result of overcompensation for oxidation. Post-radiation protection resulted from the administration of selenium salts, since they are oxidants and affect the sulfhydryl-disulfide enzyme system. Sodium selenate containing 1.28% selenite proved to be effective. Author

N63-23742 Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. DEFECTIVE FUEL ELEMENT TESTING FOR THE ML-1
Howard S. Dreyer Sept. 1963 63 p refs
(Contract AT(10-1)-880)
(AGN TM-404) OTS: $1.50

Calculations and experiments were performed to measure the steady-state release of fission gas from sheathed fuel pins with one or more pin-hole defects. Calculated values were compared with results of in-pile tests of three intentionally defected ML-1 fuel pins. The tests verified predictions that fission gas release and plate-out of fission products would not result in significant problems in the ML-1. Oxidation of fuel was not severe after one month of power operation using air as a coolant. It was concluded that the calculational method described provides an adequate prediction of fission gas release in clad fuels. Author

N63-23752 Duke U., Durham, N.C.
ON THE REPRESENTATIONS OF THE SEMI-SIMPLE LIE GROUPS II
G. E. Baird and L. C. Biedenharn Aug. 3, 1963 53 p refs
(Partially supported by Army Res. Office and NSF)

The explicit determination of the matrices of the generators of the unitary groups is carried out and discussed in two alternative treatments: (1) by purely algebraic infinitesimal methods, and (2) by Young pattern techniques employing the Schwinger–Bargmann boson operator methods. The implication of this result for a tableau calculus is discussed, and a determination of the $[\lambda] \times [1]$ Wigner coefficient for all U_n is indicated. Author

N63-23756 Air Force Cambridge Research Labs. Bedford, Mass. Optical Physics Lab.
A MODEL OF A CLEAR STANDARD ATMOSPHERE FOR ATTENUATION IN THE VISIBLE REGION AND INFRARED WINDOWS Research Report
L. Elterman July 1963 37 p 16 refs
(AFCRL-63-675)

A clear standard atmosphere for determining attenuation in the visible region and infrared windows is defined. The derivation of the model is based on a Rayleigh atmosphere with an aerosol component determined by recent sea-level and high-altitude measurements. The format of the model is a series of tabulations for 15 wavelengths from 0.4 to 4.0μ with Rayleigh and aerosol parameters arrayed at kilometer intervals to an altitude of 30 km. Horizontal, vertical, and slant-path transmission from sea-level, transmission between two altitudes, and transmission to space, are readily determined from the tabulations. Author

N63-23757 Sperry Gyroscope Co., Great Neck, N.Y.
METHODS OF DETERMINING TRANSITION PROBABILITIES AND LEVEL POPULATION DENSITIES BY SELF-ABSORPTION OF RADIATION Scientific Report No. 1
S. E. Frish and O. P. Bochkova Bedford, Mass., AF Cambridge Res. Labs., June 1963 30 p refs
(Contract AF 19(628)-2924)
(AB-1108-0006; AFCRL-63-812)

Some different variants of the self-absorption method offering the possibility of determining the optical density $\chi(0)\ell$ in the region of the center of a spectral line have been described. The calculation formula and a table of data are given for: (1) the method of the variance of the absorption length, and (2) the method of one and two mirrors. The precision of the determination of $\chi(0)\ell$ and for correspondent products of the transition probability by concentration of the atoms ($A_{ki}N_i$ and $A_{ki}N_k$) is considered. The influence of the hyperfine structure of a line on the experimental results is found. Some experimental data for the investigated discharge in neon are given. Author

N63-23758 Aerojet-General Nucleonics, San Ramon, Calif.
SELECTED SYNTHESIS BY FISSION FRAGMENT RECOIL Quarterly Progress Report No. 1, July 1-Sept. 30, 1963
A. R. Miller Oct. 1963 18 p 9 refs
(Contract AF 04(611)-9069)
(AN-1048)

Progress is reported in a study of the synthesis of two high-energy liquid oxidizers by means of fission fragment radiolysis. Irradiation capsules and fissile fuel were procured, and calibration of energy deposition was begun. One irradiation was conducted to gain handling and analytical experience. Author

N63-23771 General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
ON THE NUMERICAL INTEGRATION OF THE NAVIER-STOKES EQUATIONS FOR THE SHOCK STRUCTURE PROBLEM
A. D. Warner and Charles Muckenfuss Nov. 1, 1963 28 p 15 refs
(Contract AF 04(694)-222)
(Document 63SD713)

This report presents the design and results of a machine program for the numerical integration of the Navier–Stokes equations for the shock structure problem for a reasonable realistic Prandtl number and temperature-viscosity relationship. The program is designed to provide the maximum slope thickness and profiles of the density, velocity, and temperature; and so that the mathematical character of the solutions may be studied, such as limiting behavior for strong and weak shocks. Accordingly, the calculations are made with an arbitrary, but preassigned precision parameter. This serves as a convergence criterion which must be satisfied at several places in the calculations and provides an economic program in the sense that the precision of calculations is at the same level throughout several phases of the work. Author

N63-23783 Johns Hopkins U., Baltimore, Md.
TRANSPORT OF RADIONUCLIDES IN FRESH WATER SYSTEMS
B. H. Kornegay, W. A. Vaughan, D. K. Jamison, and J. M. Morgan, Jr., eds AEC, Div. of Tech. Inform., July 1963 404 p refs Rept. of A Working Conf., Austin, Tex., Jan. 30–Feb. 1, 1963
(Contract AT(30-1)-1477)
(TID-7664) OTS: $5.00

Papers dealing with the transport of radionuclides in freshwater systems are presented. These include the following: (1) preliminary safety analysis of radionuclide release to the Clinch River, (2) the aqueous behavior of strontium-85, cesium-137, zinc-65, and cobalt-60 as determined by laboratory type studies, (3) the behavior of radionuclides in the Columbia River, (4) the role of bottom organisms, (5) strontium uptake by algae, and (6) the transport of radionuclides in fresh water: dispersal of bed sediments. P.V.E.

N63-23793 General Motors Corp., Santa Barbara, Calif.
INVESTIGATION OF FUNDAMENTAL MECHANISM OF DAMAGE TO THIN TARGETS BY HYPERVELOCITY PROJECTILES Final Report
C. J. Maiden, J. W. Gehring, and A. R. Mc Millan Sept. 1963 127 p refs
(Contract Nonr 3891(00) (x); ARPA Order 70)
(TR63-225)

The report treats the theoretical relationships of such aspects of the problem as heating effects; impact velocities and pressures; shield materials, thicknesses, and strengths; spray angles; and the relative damage inflicted on shielded targets. The results from the test firings are then correlated with the theory to substantiate the conclusions reached. In brief, these concern the heat-induced fragmentation effect on the shield, which at higher velocities may cause complete vaporization of the projectile and insignificant frontal damage to the shielded target. However, the debris impacting on the target may still impose a severe momentum loading on the target. It was also found that, to a first approximation, shields of equal weight are equally effective, independent of shield material, against the same projectiles, and that projectiles with the highest density and melting point were the most effective against shielded targets. Author

N63-23794 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TRAPPED PARTICLES FROM HIGH-ALTITUDE NUCLEAR EXPLOSIONS

W. N. Hess Repr. from Trans. Amer. Geophys., v. 44, no. 3, Sept. 1963 p 1
(NASA RP-40)

A series of papers concerning the artificial radiation belt which resulted from high-altitude nuclear explosions are discussed. Included are data on trapped particles from the Explorer XV Satellite, measurement of particle flux by several DOD satellites, measurements from the Injun Satellites, and problems concerning the injection of electrons from the Starfish explosion. C.L.W.

N63-23800 Bettis Atomic Power Lab., Pittsburgh, Pa.
CTS-3 – A MULTI-GROUP TRANSPORT PROGRAM FOR INFINITE CYLINDERS
J. H. Bennett Sept. 1963 18 p refs
(Contract AT-11-1-GEN-14)
(WAPD-TM-396) OTS: $0.50

The program CTS-3 provides numerical approximations to solutions of the multigroup transport equation in infinite cylindrical geometry. The discretization used, which is a discrete ordinates method similar to the S_n method, the restrictions imposed by the program, and the preparation of input, are described. Author

24 PHYSICS, PLASMA

Includes: fusion; and magnetohydrodynamics.

For related information see: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N63-23039 National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
THE A. C. CONDUCTIVITY OF A PLASMA
C. S. Shen and R. L. W. Chen [1962] 21 p 10 refs
(NASA TM X-50932) OTS: $2.60 ph, $0.83 mf

This paper computes the electrical conductivity of a fully ionized, spatially homogeneous plasma under the influence of a uniform periodically-alternating electric field. The velocity distribution of the electrons is determined by solving the linearized Fokker–Planck equations. All the terms in the collision integral are retained, including those representing electron–electron interactions. Author

N63-23062 Brown Engineering Co., Inc., Huntsville, Ala.
A FORTRAN PROGRAM FOR COMPUTING REFLECTION, TRANSMISSION, AND ABSORPTION COEFFICIENTS FOR AN INHOMOGENEOUS PLASMA LAYER
B. H. Kavanaugh, Jr., and J. M. Scarborough June 1963 79 p 7 refs
(Contract DA-01-009-ORD-1019)
(R-52)

This report describes a FORTRAN computer program for computing the transmission, reflection, and absorption coefficients of a nonhomogeneous plasma layer. A modified Runge–Kutta integration scheme is used to solve Maxwell's equations for the electric and magnetic fields at the boundary of the plasma layer. Author

N63-23063 University of Southern Calif., Los Angeles
RESEARCH IN PLASMA AND MAGNETOHYDRODYNAMICS
Zohrab Kaprielian Mar. 1963 20 p 12 refs
(Grant AF-AFOSR-62-112)
(USCEC 96-101; AFOSR 4853)

The research reported involves theoretical and experimental work in five major areas: (1) electromagnetic radiation from a dipole in an anisotropic plasma; (2) plasma diagnostics; (3) modified PIG discharge hot plasma source; (4) plasma parametric amplifier; and (5) measurements of thermal radiation from a highly ionized current carrying plasma. Author

N63-23082 Pittsburgh U., Pa. Atomic and Plasma Physics Lab.
ELECTRON-ION AND ION-ION RECOMBINATION Technical Report No. 2
Manfred A. Biondi Sept. 19, 1963 49 p 39 refs
(Contract Nonr 624(06))
(APP-4)

Information obtained from laboratory experiments and theoretical calculations concerning electron–ion and ion–ion recombination processes are reviewed. It is concluded that the two-body processes of dissociative recombination and radiative recombination between electrons and positive ions, and of mutual neutralization of positive and negative ions, are of importance for the ionosphere. Auxiliary processes affecting ionospheric recombination, such as electron attachment to O_2 molecules, charge transfer both for positive ions and negative ions, and ion conversion, are briefly considered. Author

N63-23090 Princeton U., N.J. Plasma Physics Lab.
PLASMA STABILITY CRITERIA FROM CONSERVATION LAWS
C. Oberman and J. Dawson July 1963 18 p 3 refs
(Contract AT(30-1)-1238)
(MATT-210)

The Penrose criteria for the existence of unstable electrostatic oscillations of a Vlasov plasma can be derived simply from the energy-momentum conservation laws applied to marginally unstable modes. These criteria also are obtained variationally as necessary conditions for instability by extremizing the possible motions which can convert kinetic energy into electric field energy. Author

N63-23094 Princeton U., N.J. Plasma Physics Lab.
EFFECT OF A TRANSVERSE MAGNETIC FIELD ON MAGNETIC SURFACES IN A STELLARATOR WITH HELICAL WINDINGS
Dieter Eckhartt June 1963 17 p 6 refs
(Contract AT(30-1)-1238)
(MATT-197)

The magnetic surfaces, which are generated by the superposition of an $\ell = 3$ helical stabilizing field on the uniform confining field in a Stellarator, are displaced when a magnetic field is applied transverse to the confining field. The magnitude of the transverse field is supposed to be small compared to the azimuthal component of the helical field at the edge of the plasma. The displacement occurs at right angles to both the transverse field and the confining field. Experimental evidence for this effect is presented. The observed displacement is in good agreement with theoretical predictions. Author

N63-23095 Princeton U., N.J. Plasma Physics Lab.
DOPPLER TEMPERATURES IN THE C STELLARATOR
Joseph G. Hirschberg June 1963 24 p 12 refs
(Contract AT(30-1)-1238)
(MATT-200)

Kinetic temperatures of impurity ions in the hydrogen discharge of the C stellarator have been measured and compared with other temperatures. General agreement is found in a stable discharge. An explanation for a small residual discrepancy is offered. Author

N63-23122 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A MATHEMATICAL TREATMENT OF THE PROBLEM OF DETERMINING THE EIGENVALUES ASSOCIATED WITH A PARTITION FUNCTION OF AN ATOM IN THE INTERIOR OF A PLASMA
E. Baylis Shanks Washington, NASA, Oct. 1963 11 p 1 ref (NASA TN D-1111) OTS: $0.50

This paper is concerned with the determination of the numerical values of some of the eigenvalues and the total number of eigenvalues of the differential equation $x^2p'' + [2dxe^{-x} - k(k+1) - u^2d^2x^2]P = 0$. The problem arises in treating the effective ionization potential of an atom in the interior of a plasma, but is essentially a mathematical problem. Tabular data are shown listing a total of 55 of these eigenvalues for nine different cases. Author

N63-23129 North Carolina State Coll., Raleigh
MAGNETO-PLASMADYNAMIC CHANNEL FLOW WITH HALL CURRENTS
James T. Yen and Charles L. Farn Wright-Patterson AFB, Ohio, Aerospace Res. Labs. Aug. 1963 48 p 8 refs (Contract AF 33(657)-8068) (ARL-63-145)

Magnetoplasmadynamic channel flow with Hall currents is considered by using real parameters W, N_1, and N_2, defined in this report. The solutions obtained are found to be of a new type, different from the usual "Hartmann type" solutions. Several interesting conclusions are deduced. Author

N63-23160 Cornell U., Ithaca, N.Y. Graduate School of Aerospace Engineering
THE THEORY OF MAGNETOHYDRODYNAMIC FREE SURFACE WAVES
L. A. Cass Sept. 1963 111 p 13 refs (Contract Nonr-401(25))

The theory of small amplitude, planar traveling waves on a free surface for an inviscid liquid is extended to include an electrically conducting liquid in an applied (uniform) magnetic field. A dispersion relation is derived in which all the pertinent boundary conditions are incorporated. This relation is valid for arbitrary conductivity, arbitrary depth, and arbitrary magnetic-field configuration. Results are obtained by examining the following special cases: (1) small conductivity, where the propagation speed is found to be the same as for zero conductivity; (2) infinite conductivity, where disturbances generated at the surface due to wave motion are carried into the bulk of the liquid by Alfvén waves, which are reflected off the bottom surface and reach the free surface again in a propagation manner determined by the appropriate boundary conditions; (3) no magnetic-field component perpendicular to the plane of the advancing wave; and (4) arbitrary magnetic-field configurations, for which further numerical solutions of the dispersion relation are required. M.P.G.

N63-23175 Innsbruck U. (Austria) Inst. for Theoretical Physics
APPROXIMATIVE SOLUTION OF THE MAGNETOHYDRODYNAMIC EQUATIONS FOR FINITE CONDUCTIVITY Technical Note No. 4
Ferdinand Cap and G. Kerer July 25, 1963 4 p (Contract 61(052)-675)

Proceeding from the basic equations for steady two-dimensional potential flow, the basic magnetohydrodynamic equations are linearized by means of perturbation calculations disregarding gravity, friction, and thermal conduction. I.v.L.

N63-23178 Rome U. (Italy)
IONIC MOBILITY IN COLD PLASMAS Final Technical Report, Dec. 1, 1961-Nov. 31, 1962
G. Careri et al [1962] 24 p 3 refs (Contract DA-91-591-EUC-2031)

The research is divided in two general categories: investigation of the properties of ions in liquid helium, and the use of helium ions in experiments on the rotation of liquid helium. All the work was carried out at temperatures in the helium II region, that is below 2.19° K. The behavior of the positive and negative ions and their interaction with their solvent was studied through measurements of the mobility at various temperatures and applied electric fields. The experiments on rotating liquid helium are described and are grounded on the study of the space charge effect of a beam of negative charges. Author

N63-23400 Itek Corp., Palo Alto, Calif. Vidya Div.
X-RAY DENSITOMETER FOR USE IN PLASMA STREAMS
Boris Ragent N.Y., Am. Inst. of Aeron. and Astronautics [1963] 37 p refs Presented at 5th AIAA Biennial Gas Dynamics Symp. [on] Physico-Chemical Diagnostics of Plasmas, Northwestern U., Evanston, Ill., Aug. 14–16, 1963 (NASA Contract NAS2-261) (AIAA Paper 63-387) AIAA: $0.50 members, $1.00 nonmembers

An instrument has been constructed for the measurement of the mass density of a gas in a localized volume element. The principle of operation involves the measurement of the scattering of a beam of moderately hard X-rays to establish the number of scattering centers present in a scattering volume. This volume is defined by the geometrical intersection of a well-defined pencil of X-rays and collimated viewing paths of detectors. The X-ray energy utilized is high enough so that the scattering is primarily incoherent from electrons, both bound and free, so that the number of X-rays scattered into a detector per unit time is proportional only to the total electron density in the gas and not the chemical state of the gas. The gas mass density may be related to the total electron density since the number of electrons per gram is approximately constant for all common gases except hydrogen. Author

N63-23401 Douglas Aircraft Co., Santa Monica, Calif. Missile and Space Systems Div.
EFFECTS OF VISCOSITY IN MAGNETOPLASMADYNAMIC GENERATORS
J. C. Wu Aug. 1963 15 p refs Presented to the Symp. on Magnetoplasmadynamic Electrical Power Generator held at King's Coll., Newcastle Upon Tyne, Sept. 6, 1962 (Engineering Paper No. 1496)

In studies of the efficiency and performance of magnetoplasmadynamic generators, one-dimensional or quasi-one-dimensional flow theories are frequently used and the plasmas are treated as inviscid fluids. Some effects associated with nonzero viscosity of the plasma in a crossed-field dc generator are treated, and attempts are made to assess quantitatively the reduction in obtainable power densities. Author

N63-23408 Microwave Associates, Inc., Burlington, Mass.
HIGH POWER BEAM-PLASMA AMPLIFIER First Quarterly Progress Report, 15 Dec. 1962-14 Mar. 1963
M. A. Allen, C. S Biechler, P. Chorney, and H. S. Maddix May 10, 1962 104 p 28 refs
(Contract DA-36-039-AMC-00076(E); Proj. Defender)

The design of the first test vehicle is described. Experiments on plasma generation have yielded promising results with PIG discharges in xenon gas. Instabilities due to a low critical magnetic field at low fill pressures have been observed. An electron-beam tester has been constructed in order to study electron-beam behavior with various gas fills. A small signal theory of beam–plasma interaction is presented, and the preliminary outline of an approach to the large signal theory is given. Author

N63-23409 Microwave Associates, Inc., Burlington, Mass.
HIGH POWER BEAM-PLASMA AMPLIFIER Second Quarterly Progress Report, 15 Mar. 1963-14 June 1963
M. A. Allen, C. S. Biechler, P. Chorney, R. W. Gould, and H. S. Maddix May 10, 1962 94 p 12 refs
(Contract DA-36-039-AMC-00076(E); Proj. Defender)

The construction of the first test vehicle is described. Final processing prior to RF testing has been completed. Experiments on plasma generation using a PIG discharge with a gridded anode have yielded stable plasmas with high critical magnetic fields. In the electron-beam tester, the beam diameter has been experimentally measured. A detailed presentation of the approach to the large-signal analysis is given. Author

N63-23434 Aerospace Corp., El Segundo, Calif.
FLIGHT INSTRUMENTATION FOR REENTRY PLASMA SHEATH
Allen E. Fuhs July 12, 1963 45 p 20 refs
(Contract AF 04(695)-169)
(TDR-169(3153-20)TN-1; BSD-TDR-63-124)

A number of instruments for probing the plasma sheath during reentry are described. The instruments respond to the induced magnetic field produced by the interaction of the ionized gas flowing through an applied magnetic field. Flight models to measure the product of electrical conductivity and velocity, σu, and the σu profile are discussed. In addition, analysis and description of laboratory transducers for determining velocity, σu fluctuations, and average electron-collision frequency are presented. Author

N63-23471 Aerospace Research Labs. Wright-Patterson AFB, Ohio Thermo-Mechanics Res. Lab.
PROCEEDINGS OF THE FIRST PLASMA ARC SEMINAR OF THE THERMO-MECHANICS RESEARCH LABORATORY, HELD 17, 18 AND 19 SEPTEMBER 1962
Sept. 1963 622 p refs
(ARL 63-151)

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20. HEAT TRANSFER FROM PLASMAS IN THE PRESENCE OF MAGNETIC FIELDS S. A. Gordon (AeroChem Res. Labs., Inc.) p 542–556 refs (See N63-23489 24-24)

21. LAMINAR AND TURBULENT MIXING OF FIELD-FREE PLASMA J. Grey (Princeton U.) p 596–614 refs (See N63-23490 24-24)

22. A MINIATURE ENTHALPY PROBE F. C. Haas (Cornell Aeron. Lab., Inc.) p 596–614 (See N63-23491 24-24)

N63-23472 Dartmouth Coll., Hanover, N.H.
ON THE SHEATH OF HOLLOW ANODES
Robert C. Dean, Jr. *In* Aerospace Res. Labs. Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 1–17 (See N63-23471 24-24)
(Contract AF 33(657)-8179)

The coupled heat-transfer, flow, and electrical phenomena of the gas sheath on a cooled anode is investigated theoretically and experimentally. An attempt is being made to identify the various modes of electrical conduction across the sheath to

establish criteria of transition between these various modes. At least two flow regimes, one called "laminar" and the other "turbulent," are of concern. I.v.L.

N63-23473 Columbia U., New York, N.Y.
SHEATH PHENOMENA ON TRANSPIRATION COOLED ARC ANODES
C. Sheer *In* Aerospace Res. Labs. Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 18–89 refs (See N63-23471 24-24)

An understanding of the interaction phenomena between the working fluid and gas discharge components for various methods of fluid injection is necessary to an accurate knowledge of the overall energy transfer process which, in turn, is a prerequisite to the development of better arc heaters. A specific case of interaction is discussed where the working fluid is injected into the discharge zone through the anodic arc boundary by transpiration through a porous anode. I.v.L.

N63-23474 Minnesota U., Minneapolis
ANODE HEAT TRANSFER AND CHARACTERISTICS OF PLASMA STREAMS
E. R. F. Winter *In* Aerospace Res. Labs. Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 90–99 refs (See N63-23471 24-24)

The energy transfer to the anode in an argon arc was determined by an involved calorimetric method. The measured local energy transfer rates were subdivided into energy contributions stemming from the radiation, convection, and the electron energy entering the anode surface. Fluid mechanics principles were introduced into the analytical approach to the solution of the energy transfer to anodes in the electric arc. The experimental investigations of the physical characteristics of the field-free plasma streams were carried out with radiation measurement techniques. The temperature distribution in argon jets as a function of the mass flux and the power input was determined spectrographically. The total radiation emitted by the field-free jet was obtained with a thermopile. The existence of thermodynamic equilibrium in a field-free jet was checked. An overall energy balance for plasma jets was established by applying calorimetry. I.v.L.

N63-23475 Aerospace Research Labs. Wright-Patterson AFB, Ohio Thermo-Mechanics Res. Lab.
AN EXPERIMENTAL INVESTIGATION OF A VORTEX-STABILIZED LONG ALTERNATING CURRENT ARC DISCHARGE
T. Andrada and Kurt Erfurth *In its* Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 100–144 refs (See N63-23471 24-24)

Preliminary results are reported dealing with the measurement of radial distribution of mass flow and velocity vector of cold nitrogen flow at various axial positions along the confining discharge tube. It was found that, at various injection angles of the gas into the vortex generator and over a wide range of mass flow rates, the flow exhibited more of a solid-body rotation rather than a free vortex potential flow. A low-speed vortex flow in the reverse direction to the main flow occurred along the center portion of the discharge tube. The boundaries of this reverse or back flow were determined as a function of the various flow parameters. Measurements of the voltage-current relationship for various arc lengths, current, and flow field conditions indicated a negative characteristics in all cases. The overall voltage gradient, as an indication of the heat transfer from the arc column to the surrounding environment, was found to be rather insensitive to changes of mass flow rates and vortex strength. Author

N63-23476 Aeronautical Research Labs., Wright-Patterson AFB, Ohio
VORTEX STABILIZED HYDROGEN ARCS
Werner Bez *In its* Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 145–155 refs (See N63-23471 24-24)

The flow pattern in a discharge chamber for a vortex-stabilized arc will be presented, using recent experimental results of various methods for flow investigation and flow visualization. The effect of the gas flow on the plasma column will be discussed. Author

N63-23477 Electro-Optical Systems, Inc., Pasadena, Calif.
INTERACTION BETWEEN ELECTRIC ARCS AND GAS FLOWS
Eric Baum and G. L. Cann *In* Aerospace Res. Labs. Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 156–202 refs (See N63-23471 24-24)

Experimental investigations are reported here dealing with two aspects of the interaction phenomena between gas flows and electric arcs. A "Maecker type" segmented, water-cooled arc column apparatus has been constructed. In one set of experiments the properties of the arc are studied when the gas flow is very small, so that all of the power is transferred to the channel walls (asymptotic column region). A second set of experiments was carried out in which the gas flow was considerably increased, so that the heating extended over a considerable portion of the channel (inlet region). Author

N63-23478 Massachusetts Inst. of Tech., Cambridge
PLASMA ACCELERATION BY TRAVELING MAGNETIC WAVES
Eugene E. Covert *In* Aerospace Res. Labs. Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 203–225 refs (See N63-23471 24-24)

This particular program is oriented toward producing controlled laboratory experiments; thus a brief outline of the goals for the study is provided. A summary of recent research in the problem of plasma acceleration by traveling magnetic waves is presented. The studies include ionization of the gas, elementary analysis of the flow, and methods of improving the electrical efficiency. Author

N63-23479 Bonn U. (W. Germany) Inst. für Theoret. Physik
THEORY OF THE ELECTRODE COMPONENTS OF THE ARC DISCHARGE
Gunter Ecker *In* Aerospace Res. Labs. Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 226–266 (See N63-23471 24-24)

A theoretical attempt to describe the electrode components of the arc discharge is presented. The following features which are characteristic of the problem of the electrode components of the arc are discussed: (1) The column of the arc constricts in front of both electrodes. (2) The voltage requirement of the arc is small, of the order of 10 volts. (3) There exist certain "critical values" for the pressure and the current. Whereas with decreasing pressure the extension of the cathode spot grows, it changes discontinuously at the critical pressure to a very high constricted mode which moves on the surface of the cathode. Also, with increase in current, the cathode spot widens up. When the spot reaches the critical current, it again changes discontinuously to a completely different mode, the so-called arc without the cathode spot. (4) It is very difficult to ignite an arc with very clean electrodes. (5) The cathodic part of the arc shows the unexpected phenomenon of "retrograde motion" in a transverse magnetic field. I.v.L.

N63-23480 General Electric Co., Philadelphia, Pa.
THE SPACE CHARGE REGION NEAR THE ARC CATHODE
T. H. Lee *In* Aerospace Res. Labs. Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 267–274 (See N63-23471 24-24)

Perhaps the most important thing in discussing the cathode spot theories is to identify the case on hand. This case deals with trailing an arc of a few hundred amperes, either in nitrogen or in argon, with a carbon cathode of the type used in plasma generators. The space charge region is identified in mathematical language using the following steps: (1) The electron mean free path in a gas with a density gradient is calculated. (2) A model is then formulated for the cathode drop region. This model consists of four parts. In region I, the region adjacent to the cathode, both electrons and ions fall freely. In region II, the ions are mobility controlled. Region III is the ionization region, and region IV is the plasma region. (3) Poisson's equation for regions I and II are solved by numerical calculations. I.v.L.

N63-23481 Michigan U., Ann Arbor
A MICROWAVE DIAGNOSIS OF A CYLINDRICAL PLASMA WITH ALKALI METAL INJECTION-ELECTRICAL CONDUCTIVITY
Daniel N. Cheatham, Jr. (AF Inst. of Technol.) and James A. Nicholls *In* Aerospace Res. Labs. Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19 1962 p 275–293 refs (See N63-23471 24-24)
(Contract AF 33(616)-8126)

The purpose of the study was to investigate the feasibility and effectiveness of seeding high-temperature gases with low-ionization potential elements in order to achieve high levels of electrical conductivity in the seeded gas. A 28.5-megacycle R-F heater was used to reach gas temperature levels in the 2000° K to 3000° K range. Nitrogen and air were used as "working fluids"; sodium, potassium, and cesium in several forms were used as the seeding elements injected into the gas flow. Several methods of element injection were used. Electron number densities and electrical conductivity in the resulting plasma were predicted as a function of the mole fraction seeding ratio. The electron density analysis included the assumption of thermal and chemical equilibrium in the plasma. An equilibrium analysis was used to determine the important chemical reactions in the seeding process. Author

N63-23482 Vidya, Inc., Palo Alto, Calif.
REVIEW OF THE STATUS OF KNOWLEDGE OF TRANSPORT AND THERMODYNAMIC PROPERTIES OF SELECTED GASES
Boris Ragent *In* Aerospace Res. Labs. Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 294–321 refs (See N63-23471 24-24)

The presently available data on the thermodynamic and transport properties of commonly used gases are reviewed in conjunction with a generalized study of the problems associated with the production, measurement, and use of high-temperature, high-velocity gas streams. These data have been reviewed with the aim of providing recommendations for sources of data and to uncover limitations involved in the calculations or experiments yielding the data. The gases considered are air, air components, hydrogen, and the noble gases in the temperature ranges above 4000° R and in the density ranges from about $\rho/\rho_0 = 10$ to $\rho/\rho_0 = 10^{-6}$ (ρ_0 = density at stp). I.v.L.

N63-23483 Avco Corp., Wilmington, Mass.
RESEARCH ON RADIATION FROM ARC HEATED PLASMA: NITROGEN
J. C. Morris and G. R. Bach *In* Aerospace Res. Labs. Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 336–379 refs (See N63-23471 24-24)

The problems of predicting and experimentally measuring important radiative properties of high-temperature gases are discussed. The experimental apparatus for making determinations of these radiative properties is described and theoretical calculations of composition, emissivity, and line intensity are given. Nitrogen was chose as the first gas to be studied because of its engineering value to present research efforts. Temperature profiles for a nitrogen arc have been determined from the absolute line intensity of the 4935Å atomic nitrogen line, the relative intensity of the 3914Å N_2^+ (1st negative) band, and from the line width. These profiles agree rather well, indicating a condition of thermal equilibrium. Author

N63-23486 Warner and Swasey Co., New York, N.Y.
SOME SPECTROMETRIC AND SPECTRORADIOMETRIC MEASUREMENTS OF TEMPERATURE IN PLASMAJETS
R. H. Tourin, L. R. Ryan, and H. J. Babrov *In* Aerospace Res. Labs. Proc. of the First Plasma Arc. Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 446–459 refs (See N63-23471 24-24)

Temperatures and temperature distributions in plasma jets generated by a gas-stabilized arc were determined from spectral emission and absorption measurements, by several methods. The first method was a spectroradiometric method—the infrared monochromatic emission and absorption were used to determine temperature from the Kirchhoff and Planck radiation laws, without reference to energy levels or transition probabilities. The second method used the absolute intensity of a spectral line of known absolute transition probability to determine the temperature. The third method used the relative intensities and relative transition probabilities of two lines. The fourth method, the Boltzmann plot, is an extension of the third to many lines. The many-line method was applied to the rotational lines of the $N_2^+(0\text{–}0)$ band and to the atomic lines of neutral N. Author

N63-23487 Space Sciences, Inc., Natick, Mass.
A REVIEW OF MAGNETICALLY INDUCED MOTION OF ELECTRIC ARCS
Walter E. Knabe *In* Aerospace Res. Labs. Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 478–494 refs (See N63-23471 24-24)

Experimental results on arcs in magnetic fields are briefly discussed, emphasis being given to phenomena characteristic of thermal arcs. Remarks are added concerning the theory and analytic description of the arc behavior in an external magnetic field. Author

N63-23488 Aerospace Research Labs. Wright-Patterson AFB, Ohio Thermo-Mechanics Res. Lab.
SOME OBSERVATIONS ON THE MOTION OF ELECTRIC ARCS IN TRANSVERSE MAGNETIC FIELDS
Ward C. Roman *In its* Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 495–541 refs (See N63-23471 24-24)

Experiments are described dealing with an investigation of the translational motion, behavior, and electrical characteristics of electric arcs between parallel, straight electrodes in a transverse, external magnetic field at atmospheric pressure. Arc velocity and electrical characteristics were determined as functions of the following main parameters: (1) magnetic field strength up to 3500 G; (2) arc currents up to

600 amp.; (3) electrode spacing of 0.3 in. to 0.9 in. Further studies included the effects of the electrode width, current flow direction in the electrodes, electrode arrangement in open or closed flow channels and of various combinations of direct and alternating current for operating arc discharge and magnetic field. Within the limits of the investigated experimental conditions, the arc velocity was found to depend primarily on magnetic field strength and arc current. Author

N63-23489 AeroChem Research Labs., Inc., Princeton, N.J.
HEAT TRANSFER FROM PLASMAS IN THE PRESENCE OF MAGNETIC FIELDS
Stuart A. Gordon *In* Aerospace Res. Labs. Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Labs., Sept. 17–19, 1962 p 542–556 refs (See N63-23471 24-24)

The use of the standard, transient, thin-wall heat-transfer method, as generally used in wind-tunnel work, for the measurement of the stagnation point heat transfer from plasmas in the presence of magnetic fields resulted in discrepancies. A careful investigation of the apparatus and experiment in an attempt to locate systematic errors that would explain the discrepancies are discussed. I.v.L.

N63-23490 Princeton U., N.J.
LAMINAR AND TURBULENT MIXING OF FIELD-FREE PLASMA
Jerry Grey *In* Aerospace Res. Labs. Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 596–614 refs (See N63-23471 24-24)
(Contract Nonr 1858(31); ARPA Order 206-61)

The research program on laminar and turbulent mixing of partly-ionized high-temperature gases is broken down into the two major areas: turbulent flows and laminar flows. The turbulent studies have been completed. The present paper outlines some of the approaches used in making the experiments, and indicates briefly the nature of the results. In the laminar program, the theoretical analysis has been completed, including transport-property formulations in the partly-ionized argon, and laminar flows have been obtained experimentally. Author

N63-23491 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
A MINIATURE ENTHALPY PROBE
Frederick C. Haas *In* Aerospace Res. Labs. Proc. of the First Plasma Arc Seminar of the Thermo-Mech. Res. Lab., Sept. 17–19, 1962 p 596–614 (See N63-23471 24-24)
(Contract AF 33(657)-7774)

A calorimetric enthalpy probe of small size capable of continuous operation in a high temperature, high-heat flux environment, as in an arc, is described. The instrument operates by removing a sample of hot gas from the gas stream and cooling it by evaporative film cooling until the temperature of the gas sample is low enough that it may be measured by conventional means. The composition of the cooled gas sample is measured, and the total enthalpy of the hot gas entering the instrument is determined by an energy balance technique. The structure of the instrument may be maintained at a tolerable temperature level by forced convection cooling or by evaporative film cooling. The instrument has been compared for accuracy with enthalpy values corresponding to gas temperature measurement made by conventional techniques at temperatures between 2100° and 4250° R. These tests, using nitrogen as the test gas and water as the evaporative coolant, have shown an average deviation of two percent between the methods of measurement. Author

N63-23513 Michigan U., Ann Arbor Coll. of Literature, Science, and the Arts
THE PLASMA TEST PARTICLE PROBLEM
C. W. Hirt (Ph.D. Thesis) Sept. 1963 160 p refs
(NASA Grant GP-1536; Contract Nonr-1224(15))

A dissertation is presented in an attempt to give a convergent and consistent treatment of the plasma test-particle problem. Included is a review of the previous treatments of the plasma test-particle problem, i.e., the binary collision, linear hydrodynamic, dielectric constant, and linear Landau–Vlasov treatments, and a description of a modified linear solution of the hydrodynamic equations which leads to a convergent drag expression. A discussion of the derivation of a spatially homogeneous electron plasma kinetic (transport) equation is also given, and several electron kinetic equations that are frequently used are reviewed, criticized, and clarified. Finally, the convergent test-particle theories that are discussed are further developed to give a convergent electron plasma kinetic equation. C.L.W.

N63-23516 Innsbruck U. (Austria)
THE PRESSURE HILL AND THE ADIABATIC ELLIPSE IN MAGNETOGASDYNAMICS Technical Note No. 3
Ferdinand Cap and R. Skarics July 25, 1963 12 p Submitted for Publication
(Contract AF 61(052)-675)

On the basis of Bernoulli's equations for a potential flow in magnetogasdynamics, a modified Saint Venant–Wantzel formula of efflux is derived. Pressure as a function of the velocity of efflux is calculated for magnetic field strengths of 0, 5,000, and 10,000 Gauss. The equation of a modified adiabatic ellipse is deduced with the aid of an auxiliary quantity for calculation, closely based on gasdynamics. Expressions interrelating the flow velocity, the modified Mach number and the modified critical Mach number are studied. Author

N63-23565 Union Carbide Corp., Parma, Ohio Parma Research Lab.
KRYPTON FILLED THERMIONIC CONVERTER Quarterly Technical Progress Report No. 3, July 1, 1963–Sept. 30, 1963
R. Forman Oct. 1963 24 p 1 ref
(Contract AF 33(657)-10131)

Exploratory research work on irradiated inert-gas-filled thermionic diodes is presented. Tubes containing xenon and krypton have been tested in the radiation field of a 5-mw swimming-pool-type reactor, and cathode current outputs in the range of 1 amp/cm^2 have been obtained. Early breakdown effects have been observed in irradiated xenon-filled diodes at voltages as low as 0.3 v, and this effect appears to be dependent on cathode–anode spacing and pressure. At radiation dosages between 10^8 to 10^9 rads/hr, the current output of inert-gas-filled thermionic diodes increases approximately linearly with radiation dosage. Experiments to increase output in the power quadrant of the thermionic diode, used as a converter, by the design of low anode work function tubes are also described. Author

N63-23589 Vidya, Inc., Palo Alto, Calif.
TRANSPORT AND CORRELATION IN A HIGHLY IONIZED GAS Report Period, Aug. 1, 1962–July 31, 1963
M. Rudin Aug. 30, 1963 97 p refs
(Contract Nonr-3581(00); ARPA Order 207-62; Proj. Defender)
(VIDYA-101)

The computation of two-particle correlation functions and transport properties for an inhomogeneous ionized gas is

considered with a dressed-particle approach. It is demonstrated that the dressed-particle model—where particles, dressed by the charge cloud they induce, collide without distortion of the clouds, and the collisions themselves generating the clouds—can be rigorously formulated with distribution functions. Use of this dressed-particle approximation in the Born–Green–Bogoliubov–Yvon–Kirkwood chain of equations makes it necessary to consider only the one-body and two-body equations. A procedure for obtaining perturbed thermodynamic equilibrium solutions to these equations is described for an inhomogeneous plasma. From these solutions, transport properties follow immediately. Author

N63-23598 Chicago U., Ill.
A KINEMATICAL THEORY OF TURBULENT HYDROMAGNETIC FIELDS
E. N. Parker (Colo. U., Boulder) Repr. from Astrophys. J., v. 138, no. 1, July 1963 p 226–238 19 refs
(NASA Contract NsG-96-60)

A kinematical theory is developed for the rms magnetic fields produced by the interaction of turbulent eddies, of scale a and velocity v, with a large-scale weak magnetic field B_0. The principal interest lies in the small-scale magnetic field generated by the observed photospheric granules in the observed large-scale photospheric magnetic fields. The theory considers how a rope of magnetic flux is both lengthened and widened by the velocity gradients in statistically stationary, isotropic, homogeneous turbulence in which the velocity fields are given. Both the amplification and diffusion of the magnetic field are then computed from the proportions of the rope of flux. The conclusion is that a weak field B_0 can be amplified by a factor of the order of $R^{1/4}/\ln R$, where R is the magnetic Reynolds number. In the solar photospheric granules, this amounts to amplification by a factor less than 10, so that the small-scale rms fields resulting in quiet regions where $B_0 \sim 1$ gauss are far below the value for equipartition of energy with the velocity field. Author

N63-23639 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
THE SOLUTION OF CERTAIN NONSTEADY-STATE PROBLEMS OF MAGNETOHYDRODYNAMICS FOR A VISCOUS INCOMPRESSIBLE FLUID
O. A. Ladyzhenskaya and V. A. Solonnikov May 22, 1963 84 p refs Transl. into ENGLISH from the book "Trudy Matematicheskogo Instituta Imeni V. A. Cteklova, Matematikcheskiye Voprosy Gidrodinamiki i Magnitnoy Gidrodinamiki Diya Vyazkoy Neszhimayemoy Zhidkost" Akad. Nauk SSSR Soyuza Sovetskikh Sotsialisticheskikh Respublik (Moscow), v. 59, 1960 p 115–173
(FTD-TT-63-208/1+2+4)

Problems arising from the complex interaction of electromagnetic and hydrodynamic fields are discussed. These problems were of three types, each having its own features. In the first problem, all phenomena are studied only within a region Ω_1 filled with fluid. It is isolated from the environment by an ideal conductor so that all fields are absent outside of Ω_1. In the second problem, a region Ω consists of the region Ω_1 filled with conducting fluid, of region Ω_3, a solid conductor through which flow the given currents j_0, and of region Ω_2 surrounding Ω_1 and Ω_3 and filled with dielectric or vacuum. Region $\Omega = \Omega_1 \cup \Omega_2 \cup \Omega_3$ is isolated by an ideal conductor from this entire space. In the third problem, investigations are carried out in the entire space R_3. The given electromagnetic field is maintained to infinity. Space R_3 is entirely filled with a dielectric, except the particular area Ω in which the conducting fluid moves. C.L.W.

N63-23653 National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATION OF PLASMA AFTERGLOWS WITH APPLICATION IN NITROGEN
K. C. Stotz (Rensselaer Polytechnic Inst.) Nov. 1963 100 p refs
(NASA Grant NsG-48-60)
(NASA TN D-2226) OTS: $2.25

A discussion of electron loss mechanisms in low-density, low-temperature plasmas is presented. A method of measuring the radiation temperature employing a gated microwave radiometer is discussed. Measurements of the ambipolar diffusion coefficient and recombination coefficient in a room-temperature nitrogen plasma are obtained using the microwave transmission technique as a basic diagnostic tool. Previous results obtained by using the microwave transmission method are shown to be in error, and results of the present experiment are shown to be in agreement with microwave cavity measurements. The recombination is attributed to the dissociative recombination of the N_4^+ ion, although the three-body recombination of the N_2^+ ion may play a significant role. The temperature measurements have indicated a source of hot electrons in the early afterglow which is attributed to the presence of metastable molecules. Author

N63-23734 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
ON THE CONSTANCY OF TANGENTIAL RUPTURE IN A RAREFIED PLASMA
L. D. Pichakhchi May 28, 1963 9 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 6, no. 1, Jan.–Feb. 1961 p 86–92
(FTD-TT-63-182/1+2)

Problems concerning the constancy of tangential rupture in a plasma have been analyzed on the basis of the magnetohydrodynamic equations of Chu, Goldber, and Lou. In general, the case of arbitrary parameters, which characterize the rupture, obtained an adequate constancy condition. The magnetic field and speed lie in the rupture area and experience arbitrary jumps (discontinuity). When the jump was experienced only by the speed of the plasma, a zone of constancy was attained. R.T.K.

N63-23773 Naval Ordnance Lab., White Oak, Md.
INVISCID MAGNETOHYDRODYNAMIC FLOW NEAR THE STAGNATION POINT OF A MAGNETIZED SPHERE
E. L. Harris Oct. 1963 42 p 4 refs
(NOLTR 63-61; Aerodynamics Res. Rept. 194)

This report presents the results of a theoretical investigation into the flow of an electrically conducting, incompressible fluid over a sphere. The sphere has a magnetic dipole at its center. The magnetic Reynolds number was assumed to be small, and an asymptotic expansion in terms of it was used to obtain the first-order magnetohydrodynamic effects on the velocity and pressure. The vorticity on the surface of the sphere is infinite. Numerical results were obtained for the velocity and pressure in the neighborhood of the stagnation streamline. Author

N63-23777 Republic Aviation Corp., Farmingdale, N.Y.
SPECTROSCOPIC STUDIES OF IMPLODING PLASMA RINGS IN DETONABLE GAS MIXTURES
Kenneth M. Foreman and Maurice E. Levy May 15, 1963 32 p refs
(Contract AF 49(638)-552)
(RAC-865A; PPL-TR-62-16)

Spectroscopic observations have been made of the flow field behind a cylindrical, hypersonic wave front resulting from an imploding electrical discharge into an initially low-pressure quiescent gas. Submicrosecond resolved spectra were

obtained by use of a quartz prism monochromator–photomultiplier detector system with photographic recording of an oscilloscope displayed output signal. Electrically produced plasma rings were established in detonable as well as nonreactive gases. Strong indications were observed that exothermic reactions, as evidenced by OH emission, proceed in $H_2 + 1/2\ O_2$ reactant mixtures within less than one microsecond under certain initial low-pressure conditions. A reaction threshold at 1 mm Hg atm pressure was found for the particular reaction vessel used. Time-integrated spectrometer photos support the conclusions reached with the transient spectra analysis equipment. Author

25 PHYSICS, SOLID-STATE

Includes: semiconductor theory; and masers.

For related information see: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N63-23007 Space Technology Labs., Inc., Redondo Beach, Calif.

CHARGED PARTICLE RADIATION DAMAGE IN SEMICONDUCTORS, III: THE ENERGY DEPENDENCE OF PROTON DAMAGE IN SILICON

J. M. Denney, R. G. Downing, and G. W. Simon Oct. 4, 1962 22 p 19 refs

(NASA Contract NAS5-1851)

(NASA CR-51742; Rept. 8653-6005-KU-000; MR-22) OTS: $2.60 ph, $0.86 mf

The defect density in silicon resulting from proton bombardment has been calculated from 10 Mev to 1.8 Bev and compared with experimental results at 20.5 Mev, 95.5 Mev, 400 Mev, 450 Mev, and 740 Mev. The results show that Rutherford scattering of the protons dominates defect production at low proton energies. Above 50 Mev, recoil nuclei resulting from spallation contribute significantly to the damage process. Good agreement between theory and experiment is found, using the change in short-circuit current density of solar cells as the experimental measure of lattice defects. Author

N63-23018 Aerospace Information Div., Library of Congress, Washington, D.C.

KINETICS OF STIMULATED MOSSBAUER RADIATION [KINETIKA INDUTSIROVANNOGO MOSSBAUEROVSKOGO IZLUCHENIYA]

B. V. Chirikov Aug. 9, 1963 12 p 12 refs Transl. into ENGLISH from Zh. Eksperim. i Teor. Fiz. (Moscow), v. 44, no. 6, June 1963 p 2016–2022

(AID T-63-106) OTS: $1.60 ph, $0.80 mf

The kinetics of stimulated Mössbauer radiation in an inorganic crystal are examined under conditions such that the characteristic time of the process is much less than the width of the line. It is shown that the maximum of the wave will be shifted with a very low velocity, proportional to the line width. Author

N63-23053 Joint Publications Research Service, Washington, D.C.

PRINCIPLES OF THE DISLOCATION THEORY

B. K. Vul'f and K. P. Romadin Sept. 12, 1963 13 p Transl. into ENGLISH of Chapt. III from book "Aviatsionnoye Metallovedeniye", Moscow, 1962 p 125–133

(JPRS-21051; OTS-63-31748) OTS: $0.50

The two basic types of dislocations (imperfections or defects) in the crystal lattices of metals are discussed. Methods are given through which both edge dislocation and screw dislocations are formed, and the schemes of formation are demonstrated in the form of diagrams. The growth of crystals containing dislocations are included in the discussion, along with the effect of dislocations on the strength of metals. C.L.W.

N63-23061 Oregon U., Eugene

DYNAMICS OF BLOCH ELECTRONS IN SOLIDS [Progress Report] Oct. 1, 1962 to Present

Gregory H. Wannier [1963] 4 p

(Contract Nonr 2771(05))

Progress is reported in an investigation into the behavior of an electron which is confined to a single Bloch band, and which is assumed to be governed, for most purposes, by a Hamiltonian characteristic for that band; this Hamiltonian can be treated classically or semiclassically with a Bohr–Sommerfeld quantization rule in many cases. P.V.E.

N63-23084 Clevite Corp., Palo Alto, Calif. Shockley Lab.

RESEARCH ON SEMICONDUCTOR TRANSPORT Annual Summary Report, Oct. 1, 1962–Sept. 30, 1963

[1963] 4 p 3 refs

(Contract Nonr 2934(00))

Results are reported in the exploration of the interaction of phonons (lattice vibrations) with charge carriers and effects closely related to these in the following areas: (1) a simplified model for phonon scattering by grain boundaries, (2) phonon mean free path in silicon between 77° and 250° K, (3) measurement of phonon-phonon scattering in silicon at 4.2° K, (4) design of an experiment and preliminary measurements aimed at phonon focusing and phonon diffraction in silicon, and (5) acoustic amplification of relevant thermal phonons. P.V.E.

N63-23114 Johns Hopkins U., Baltimore, Md. Dielectrics Lab.

DIELECTRICS FOR SATELLITES AND SPACE VEHICLES Final Report, Mar. 1, 1962–Mar. 31, 1963

Louis J. Frisco, A. M. Muhlbaum, and Edward A. Szymkowiak Apr. 30, 1963 104 p 23 refs

(Contract DA-36-039-SC-89147)

High-vacuum sparkover measurements in the presence of a strong magnetic field show that the breakdown voltage does not depend on effects produced by primary electrons striking the anode. Preliminary results indicate that X-ray induced conductivity, σ_x, in Mylar-C, TFE-7, and polyethylene was voltage dependent, following the relationship $\log \sigma_m \approx V$. At a fixed voltage, σ_m was proportional to R^{Δ}, where R is the dose rate and Δ is a constant. With Mylar-C, σ_x is temperature dependent, showing a complex behavior in the range of the second-order transition temperature. X-ray induced ac losses in TFE resins are greatly influenced by the presence of oxygen during sintering. An improved specimen for electric strength measurements on solids, at frequencies up to 100 Mc, is described. Author

N63-23156 Princeton U., N.J. Plasma Physics Lab.

KINETIC EQUATIONS FOR ELECTRONS AND PHONONS

Amiram Ron Apr. 1963 34 p 17 refs

(Contract AT(30-1)-1238)

(MATT-182)

A method is presented for deriving a set of kinetic equations for a system of electrons and phonons in a simplified model of a metal. By employing the second quantization

representation for the creation and annihilation operators of the electrons and the phonons, a hierarchy of equations for the distribution functions and correlation functions is introduced. This hierarchy is studied, using an approach originally developed by Bogoliubov, where both truncation of the hierarchy and irreversibility are achieved under general assumptions. A set of kinetic equations is obtained for a homogeneous system, where the electrons dynamically shield both each other and the phonons. Author

N63-23167 California U., Berkeley Electronics Research Lab.
DIATOMIC GAS OPTICAL MASER WITH EXPLODING WIRE PUMPING SOURCE
L. Hajdu June 5, 1963 41 p 23 refs
(Grant DA-ARO(D)-31-124-G317; Contract AF 49(638)-102) (Rept. 63-12; AROD-33233)

The feasibility of a gaseous maser in which the excited atoms are produced through photochemical decomposition of diatomic molecules (such as N_2, O_2, and NO) is studied. As an example, the photodissociation of NO is discussed in detail. Because of the required high excitation energies, the useful pumping band of such a system is in the extreme ultraviolet. Exploding wire is suggested as a suitable light source, having very intense output in the vacuum ultraviolet, with excellent reproducibility of its spectral characteristics per flash. Preliminary experiments show that when N_2 and O_2 molecules are photoactivated by the light output of an exploding wire, the 7468.8 A nitrogen and 8446 A oxygen emission lines appear with relatively high intensities. Author

N63-23179 International Business Machines Corp., Yorktown Heights, N.Y.
LOW TEMPERATURE VAPOR GROWTH STUDIES Scientific Report No. 1
A. Reisman July 1, 1963 131 p 11 refs
(Contract AF 19(628)-2468)
(AFCRL-63-363)

Studies have been initiated to explore the potential of utilizing chemical and physical perturbing influences to extend the temperature ranges of well-known and novel vapor-transport reactions, and to determine which parameters most affect deposition characteristics in epitaxial growth of semiconductors from the vapor. Germanium has been employed almost exclusively as a prototype material in the initial work. A series of extensive thermodynamic analyses of systems containing Ge and/or Ga with H and/or He and I_2 have been completed. Based on these analyses, studies of transpiration conditions for iodine and germanium source beds in an inert carrier stream have been begun, and a disproportionation flow system using HI and H_2/He carrier gas mixtures has been designed, constructed and tested. Author

N63-23246 Paris U., Orsay (France)
STRAGGLING OF ENERGY LOSS BY HIGH ENERGY ELECTRONS IN SOLIDS
G. R. Bishop *In its* Invest. of Density Effects in Solids and Gases [1962] 10 p (See N63-23243 24-01)

An apparatus for investigating the straggling of energy loss by high-energy electrons in solids is described. P.V.E.

N63-23249 Paris U., Orsay (France)
DENSITY EFFECT IN SOLIDS AND THE STRAGGLING CURVE OF ENERGY LOSS BY RELATIVISTIC ELECTRONS
G. R. Bishop *In its* Invest. of Density Effect in Solids and Gases [1962] 22 p refs (See N63-23243 24-01)

The value of the most probable energy loss for an electron in collision with a solid and the shape of the straggling curve for graphite, Al, Fe, Cu, Ag, Au, Ni, and Ta are presented. Both energy loss by collisions and bremsstrahlugn radiation are considered. Bremsstrahlung radiation leads to half widths considerably larger than the straggling of the ionization energy loss. Most of the necessary correction (bremsstrahlung correction) is accounted for by the theory of Blunck and Westphal, although the measurements generally exceed the calculated values by up to 9% (Ta). Such discrepancies need not be taken seriously, however, since the bremsstrahlung correction is difficult to evaluate and depends on an approximate form for the bremsstrahlung spectrum. The large effect of the bremsstrahlung radiation renders difficult the determination of the role played by resonant energy transfers. P.V.E.

N63-23267 Stockholm U. (Sweden) Inst. of Theoretical Physics
THEORETICAL INVESTIGATIONS OF THE ELECTRONIC STRUCTURES AND STATES OF MOLECULES AND CRYSTALS Final Technical Report, Mar. 1, 1962-Feb. 28, 1963
Inga Fischer-Hjalmars and Stig Flodmark [1963] 160 p 68 refs
(Contract DA-91-591-EUC-2270)

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2. ENERGY BAND CALCULATIONS FOR ZIRCONIUM-OXYGEN CRYSTALS, APPENDIX B S. Flodmark 59 p 21 refs (See N63-23269 24-25)
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4. SYMMETRY PROJECTION PROGRAMME, APPENDIX D S. Flodmark 21 p (See N63-23270 24-25)
5. AN ANALYSIS OF CALCULATIONS ON SOME OXYGEN HYDRIDES, APPENDIX E J. L. J. Rosenfeld 19 p 19 refs (See N63-23271 24-25)

N63-23268 Stockholm U. (Sweden) Inst. of Theoretical Physics
A LIGAND FIELD TREATMENT OF THE ZIRCONIUM-OXYGEN CRYSTAL, APPENDIX A
Björn Roos *In its* Theoret. Invest. of the Electron. Struct. of Mol. and Crystals [1963] 24 p 10 refs Submitted for Publication (See N63-23267 24-25)
(Tech Rept. 11)

A calculation of ligand field states in ZrO_x for four different values of the oxygen concentration x is reported. The two lattice parameters a and c, and the degree of ionization τ were varied in the BESK computer program and an energy minimum was obtained for each value of x using different suitable atomic orbital exponents. The optimum results obtained for a(x) and c(x) agree remarkably well with experiment, and although no experimental data exists for comparison of the degree of ionization τ(x) obtained, the results also seem very reasonable. These computations indicate that the ion charge of oxygen in the crystal increases from 1 to about 1.73 electron charges for $0<x<1/3$. M.P.G.

N63-23269 Stockholm U. (Sweden) Inst. of Theoretical Physics
ENERGY BAND CALCULATIONS FOR ZIRCONIUM-OXYGEN CRYSTALS, APPENDIX B
Stig Flodmark *In its* Theoret. Invest. of the Electron. Struct. of Mol. and Crystals [1963] 59 p 21 refs Submitted for Publication (See N63-23267 24-25)

The development and testing of an energy band program for the BESK computer is reported, and the results obtained for the ionic crystal energy and symmetry relations of the zirconium-oxygen crystal are summarized. Several accuracy checks of the program indicate the correctness of all the parts of the program. The preliminary results for zirconium indicate that it is conductive and that its valence bands consist essentially of d and f orbitals with a small contribution from s and p orbitals. In the valence band, 5s is not present, and the $f_{\phi 2}$ orbital with a suitably chosen orbital exponent is found to be particularly essential for chemical binding. The ground state configuration of the crystal N shell electrons for the two Zr atoms in the unit cell is described. The energy bands are found to be steepest along the crystal axes in the xy plane, corresponding to a lower conductivity in the z direction. Further numerical results are being prepared for publication. M.P.G.

N63-23270 Stockholm U. (Sweden) Inst. of Theoretical Physics
SYMMETRY PROJECTION PROGRAMME, APPENDIX D
Stig Flodmark *In its* Theoret. Invest. of the Electron. Struct. of Mol. and Crystals [1963] 21 p (See N63-23267 24-25)

A FORTRAN program for the symmetry projection of Bloch orbitals forming linear combinations of atomic orbitals in crystals of arbitrary symmetry is presented. This program can be used, as well, for atomic orbitals under the influence of ligand fields. It is also possible to get the rectangular symmetry reduction matrices printed out by means of a certain indication in the input data. The output presented corresponds to wave vector No. 15 (Ik = 0) of a previously given input data list. M.P.G.

N63-23271 Stockholm U. (Sweden) Inst. of Theoretical Physics
AN ANALYSIS OF CALCULATIONS ON SOME OXYGEN HYDRIDES, APPENDIX E
J. L. J. Rosenfeld *In its* Theoret. Invest. of the Electron. Struct. of Mol. and Crystals [1963] 19 p 19 refs Submitted for Publication (See N63-23267 24-25)
(Partially supported by Swed. Nat. Sci. Res. Council)

Wave functions for OH^- and H_4O^{++} are presented in the self-consistent field molecular-orbital approximation, using a minimum basis set of Slater-type atomic orbitals. A wave function for H_4O^{++} based on a one-center model is also included. A comparison is made, for the isoelectronic series OH^-, H_2O, H_3O^+, H_4O^{++}, of three methods of calculating molecular energies, namely the two methods already mentioned and a valence bond method. The changing properties of the OH bond in the series are discussed within the self-consistent field approximation by an analysis of the electron distribution. A good correlation is found between the bond strength and the maximum in the bond of the δ function. Author

N63-23312 Air Force Cambridge Research Labs., Bedford, Mass.
GEODETIC APPLICATIONS OF LASERS
Paul B. Swenson *In its* Compendium of Papers in the Fields of Geodesy and Planetary Geometry Aug. 1963 4 p Presented to the Geodetic Planning Factors Conf., Orlando AFB, Dec. 1962 (See N63-23301 24-01)

Two uses of lasers in geodetics are discussed. In the first, a laser pulse would be directed at a satellite which carries a prismatic or retrodirective reflector. The reflected beam would be photographed by stellar cameras as a point source in the reference star background, and then the plates would be handled like any other geodetic stellar plate. In the second, a laser pulse would be used to measure accurately the relative heights of the surface features of the moon. This would be accomplished by beaming a very short laser pulse to the moon and measuring its transit time out and back. P.V.E.

N63-23376 Clevite Corp., Palo Alto, Calif. Shockley Lab.
RESEARCH ON SOLID STATE NOISE DEVICES Annual Scientific Report, [June 13, 1962–July 31, 1963]
Roland H. Haitz Aug. 1963 99 p 28 refs
(Contract DA 49-196-ORD-1086)

This report is concerned with two problems: (1) the investigation of the basic mechanisms of avalanche breakdown and (2) their application to the generation of high-amplitude white noise with considerable temperature independence. A model for the electrical behavior of microplasmas is described containing four independent parameters. This model is extended to uniform avalanche breakdown. An influence of traps within the space charge layer of a junction on breakdown voltage and pulse rate has been found. A further contribution to the pulse rate is shown to arise from an interaction between various microplasmas. For high-amplitude noise generation, uniform avalanche diodes are superior to microplasma devices. Two methods to reduce the temperature dependence of the noise output are described. Author

N63-23467 Florence U. (Italy) Istituto di Fisica della Radiazione
RESEARCH ON LASER [RICERCHE SUL LASER]
G. Toraldo di Francia *In* 1st. Superiore di Sanita, Rome The Seminar at the Physics Lab. during the Period Jan.–Apr. 1963 Part II p 74–88 In ITALIAN (See N63-23465 24-23)

Laser research and possible laser applications are discussed. Trans. by P.F.E.

N63-23526 Bell Telephone Labs., Inc., Murray Hill, N.J.
SOLID-STATE MASER RESEARCH Final Report, 20 June 1962-19 June 1963
H. E. D. Scovil June 19, 1963 73 p refs
(Contract DA-36-039-sc-89169)

CONTENTS:

1. THE FILLING FACTOR OF THE TRAVELING-WAVE MASER W. J. Tabor p 9–16 refs (See N63-23527 24-25)
2. THE ISOLATOR INCORPORATED IN THE TRAVELING WAVE MASER F. S. Chen p 16–25 refs
3. PART V—MASER PROPERTIES OF Cr^{+++} IN $ZnWO_4$ AT L-BAND W. G. Nilsen p 26–40 refs (See N63-23528 24-25)
4. PART VI—A GENERAL THEORY OF CROSS RELAXATION W. J. C. Grant p 41–62 refs (See N63-23529 24-25)

N63-23527 Bell Telephone Lab., Inc., Murray Hill, N.J.
THE FILLING FACTOR OF THE TRAVELING-WAVE MASER
W. J. Tabor *In its* Solid-State Maser Res. June 19, 1963 p 9–16 refs (See N63-23526 24-25)

The filling factor for a traveling-wave maser (TWM) loaded only on one side is determined. Using a filling factor previously determined for a TWM completely filled with active material, the advantage or disadvantage of loading a maser on both sides of the comb or on only one side is discussed. An increase in electronic gain at midband is shown when the second side of the comb is filled with ruby, and 10 Gc a 30-percent increase in gain can be obtained by loading the second side with ruby. It is concluded that two-sided loading is more efficient at least up to X-band, although not by a very large margin. P.V.E.

N63-23528 Bell Telephone Labs., Inc., Murray Hill, N.J.
MASER PROPERTIES OF Cr^{+++} IN $ZnWO_4$ AT L-BAND
W. G. Nilsen *In its* Solid-State Maser Res. June 19, 1963 p 26-40 refs (See N63-23526 24-25)

The suitability of this material for L-band masers was studied and was found to give a gain (db)-bandwidth product superior to that of ruby maser material. However, the operating conditions for the maser material, i.e., temperature, frequency, and magnetic field make it impossible to find a companion isolator material for the design of traveling-wave masers. Author

N63-23529 Bell Telephone Labs., Inc., Murray Hill, N.J.
A GENERAL THEORY OF CROSS RELAXATION
W. J. C. Grant *In its* Solid-State Maser Res. June 19, 1963 p 41-62 refs (See N63-23526 24-25)

A critical examination of existing theories of cross relaxation revealed room for an improved, more rigorous treatment. This theory of cross relaxation was developed for single spin flips, and subsequently extended for multiple spin flips. The theory was used to explain pertinent experimental observations. Author

N63-23544 Hughes Research Labs., Malibu, Calif.
LASER DEVICES EXPLORATORY INVESTIGATION Interim Scientific Report No. 1, 1 May 1963-31 July 1963
[1963] 54 p refs
(Contract AF 33(657)-11650)

CONTENTS:

1. SINGLE MODE CW INVESTIGATION p 3-7 refs
2. MATERIALS GROWTH AND SPECTROSCOPY p 7-21
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5. APPENDIX II—MEASUREMENT OF RAMAN SCATTERING CROSS SECTIONS FOR USE IN CALCULATING STIMULATED RAMAN SCATTERING EFFECTS F. J. Mc Clung and D. Weiner p 42-49 6 refs (See N63-23546 24-25)

N63-23545 Hughes Research Labs., Malibu, Calif.
CHARACTERISTICS OF RUBY LASER MODES IN A NOMINALLY PLANE PARALLEL RESONATOR
V. Evtuhov and J. K. Neeland *In its* Laser Devices Exploratory Invest. [1963] p 30-41 11 refs Submitted for Publication (See N63-23544 24-25)

Characteristics of ruby-laser modes in a nominally plane-parallel resonator were investigated. Results indicate that: (1) The modes observed in ruby lasers are those of a resonator with curved, but not necessarily spherical, end plates. (2) Most ruby lasers operate in such modes or a superposition of them rather than in the modes of a truly plane-parallel resonator. (3) Laser action is likely to start in areas of greatest effective end-plate curvature, in the case of rubies of large cross-sectional area, since the modes in such areas have the lowest losses. (4) The laser output, in the far field, consists of a center spot which results from superposition and interference of excited modes and Fabry-Perot rings, which are believed to be basically unrelated to the true modes. I.v.L.

N63-23546 Hughes Research Labs., Malibu, Calif.
MEASUREMENT OF RAMAN SCATTERING CROSS SECTIONS FOR USE IN CALCULATING STIMULATED RAMAN SCATTERING EFFECTS
F. J. Mc Clung and D. Weiner *In its* Laser Devices Exploratory Invest. [1963] p 42-49 6 refs Submitted for Publication (See N63-23544 24-25)

The magnitude of stimulated Raman scattering (SRS), of the Raman laser effect, depends upon the peak values of ordinary Raman scattering cross sections, just as ordinary laser gain depends upon the peak value of an absorption cross section. Results are given of the first measurements of peak Raman scattering cross section for three Raman lines in nitrobenzene, benzene, and toluene for which SRS has been studied, and for two other lines, in benzene and toluene, from which no SRS could be produced within certain experimental limits. The characteristics of SRS as calculated from these cross sections agree with SRS threshold measurements for these substances. A ruby laser was used as the light source in the Raman spectrometer. Photometric detection was used with a 2-m grating spectrograph as the dispersing element. Author

N63-23550 Linde Co., East Chicago, Ind.
RUBY IMPROVEMENT FOR LASER – TASK I: Final Report, No. 4, May 1, 1962-May 31, 1963
R. L. Hutcheson [1963] 33 p
(Contract DA 36-039-SC-98089)

The effect of thermal gradients, growth rate, annealing cycle, fluxing agents, and orientation on the growth of ruby via the flame-fusion crystal growth is discussed. Data on crystals grown under the best selected parameters are presented. Author

N63-23556 Technical Research Group, Inc., Melville, N.Y.
RESEARCH ON PROPERTIES OF LASER DEVICES Fifth Quarterly Technical Summary Report, June 1963-Aug. 1963
S. Rothberg, ed. [1963] 134 p refs
(Contract AF 49(638)-673; ARPA Order 356-62; Proj. Defender)
(TRG-134-QTR-5)

The limitations on power and efficiency of gas lasers were analyzed. Lamp and laser tube construction including provision for pumping of the CsBr photodissociation laser has been completed. A preliminary literature search for transition metal molecules suitable for high-power gas lasers was carried out. The development of apparatus for the nuclear fission pumping of solid-state media is continuing. Various crystalline and noncrystalline media containing rare-earth elements have been prepared. The action of the Lummer-Gehrcke plate Q-switch has been successfully demonstrated. The angular brightness measurements of the He-Ne laser were made as a function of cavity length for a sphere-flat resonator. Author

N63-23590 Naval Ordnance Laboratory, White Oak, Md. Applied Physics Dept.
SOLID STATE RESEARCH FOR THE YEAR 1962
Nov. 1963 68 p refs
(NOLTR-63-151)

The materials preparation program has succeeded in growing high-quality single crystals of both PbTe and SnTe, and in addition a method has been developed for varying the stoichiometry over a large range. Considerable emphasis has been placed upon the relationship between the magnetization and elastic properties of the crystal lattice, with particular concern directed towards magnetostriction in garnet materials. The unsymmetrical oxygen position found in fused SiO_2 has now been observed in the glasses Ge_2O_3 and B_2O_3. Neutron diffraction studies of MnF_2 have shown, for the first time, the direct observation of covalently bonded electrons. The intermetallic phase $Ti_2Ni \rightleftharpoons TiNi \rightleftharpoons TiNi_3$ has been examined in further detail. Author

N63-23724 Air Force Systems Command Wright-Patterson AFB, Ohio Foreign Tech. Div.
ON THE QUESTION OF THE CHARGE, MASS, AND ENERGY BALANCE IN THE COLLISION OF SLOW IONS WITH SOLID STATE ATOMS
U. A. Arifov Nov. 7, 1962 23 p refs Transl. of an Article from Trudy, Tashkentsk. Konf. po Mirnomy Ispol'z. At. Energi., v. 1, 1961 p 210–222
(FTD-TT-62-851/1+2+4)

A procedure for investigating the basic parameters of secondary phenomena (scattering, vaporization, diffusion, cathode sputtering, thermionic emission, adsorption, and neutralization of ions) is discussed. The basis of the procedure is as follows: The primary ion beam, accelerated by the filament-casting field of the source, impinges upon a cylindrical condenser, where it is freed of neutral atoms. The beam is then intensity-modulated by a 500- to 1000-cps rectangular-pulse generator, and directed to the target. The secondary emission current is gathered by a collector, the potential of which, in respect to the target, is modulated by a 25-cps sawtooth voltage generator. This current is fed to the input of the vertical amplifier of an oscillograph. The horizontal sweep of this oscillograph is synchronized with the sawtooth generator. This procedure for studying secondary phenomena permits the separate investigation of the behavior of the inertial and inertialless components of secondary current and thereby results in the deciphering of a whole series of complicated processes occurring simultaneously on the surface of a solid under the action of atomic particle bombardment. I.v.L.

N63-23791 Bell Telephone Labs., Inc., Murray Hill, N.J.
A DIFFRACTION LIMITED OSCILLATOR
John G. Skinner and J. E. Geusic [1963] 14 p refs Submitted for Publication
(Supported by Army)

Work is described in an attempt to show that it is possible to obtain a diffraction-limited beam from a ruby oscillator, and that output power can be increased by using an internal limiting device over a limited range. A pulsed ruby-laser beam was obtained with a diameter of 0.6 cm and an angular divergence equal to the diffraction limit of the system, even for pumping energies that are well above the threshold value but that are unable to optically pump the ruby rod uniformly across a large diameter. Black diamond was used for the limiting aperture. The beam output power increased when the system was operated near the diffraction limit using an internal limiting device, but the beam energy decreased. C.L.W.

N63-23792 Radio Corp. of America, Burlington, Mass.
PROGRAM 706. TASK 2. INVERTERS EVALUATION SECOND QUARTERLY PROGRESS REPORT
July 20, 1963 15 p refs
(Contract AF 04(695)-273)
(SSD-TDR-63-183-(II))

The purpose of the work was to fabricate, test, and deliver, two 500/25-va inverters. The 25-va inverter was redesigned to optimize frequency stability and suppress the overshoot transient at turn-on. Author

N63-23809 Boeing Co., Renton, Wash.
STUDY OF ADVANCED SOLID STATE INFRARED DETECTION Final Report
D. W. Nyberg, G. W. Flint, J. N. Churchill, H. G. Sippach, W. Chen and R. E. Oettel [1963] 241 p refs
(ASD-TDR-62-977; D6-4140; AD-298002)

Single-crystal ferroelectrics and single-crystal semiconductors were studied for use as thermal radiation detectors. The phenomenon of impact ionization of impurities in semiconductors was studied as a possible technique for infrared detection. The feasibility of shifting the spectral sensitivity of certain photoconductive crystals toward longer wavelengths by acoustical excitation of the crystal lattice was investigated. Single-crystal phosphors are being studied for use as cooled infrared quantum converters. Author

26 PROPELLANTS AND COMBUSTION

Includes: fuels; igniters; and oxidizers.
For related information see: 07 Chemistry; and 27 Propulsion.

N63-23025 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
THE DESIGN AND DEVELOPMENT OF A SHORT-DURATION CONSTANT PRESSURE COMBUSTOR FOR USE IN ROCKET BASE HEATING INVESTIGATIONS
C. Matthis, R. Muench, and W. Rickard Dec. 1962 46 p 12 refs
(NASA Contract NAS8-823)
(NASA TM-X-51978; HM-1510-Y-2) OTS: $4.60 ph, $1.58 mf

The design philosophy and development program for short-duration combustors to simulate liquid-rocket engine exhaust flows is reported. This particular combustor has been employed to duplicate liquid hydrogen–liquid oxygen and RP-lox systems, but is applicable to any liquid system for which the fuel and oxidizer can be adequately synthesized by gases or mixtures of gases. The basic principle is to store the fuel and oxidizer gases in charge tubes separated from a mixer–injector and combustion chamber by diaphragms. Rupture of the diaphragms permits the gases to flow into the combustor, whereupon ignition and burning takes place. During the length of time required for expansion waves to travel the length of the charge tubes and return, supply conditions are steady. The design considerations for each of the system components are discussed. Operating characteristics and performance data are presented. Author

N63-23041 Georgia Inst. of Tech., Atlanta Engineering Experiment Station
CHEMICAL SYNTHESIS REQUIRING CRYOGENIC TEMPERATURES AS PREPARATIVE TECHNIQUES FOR HIGHLY ENDOTHERMIC CHEMICAL SPECIES Final Report
Henry A. Mc Gee, Jr. Aug. 1963 50 p 31 refs
(NASA Grant NsG-123-61)
(NASA CR-51656) OTS: $4.60 ph, $1.70 mf

Progress reported is as follows: (1) The time-of-flight mass spectrometer has been slightly modified, and a cryogenically cooled, sample inlet system has been designed and constructed. In this design, the ionizing electron beam of the spectrometer makes grazing tangential incidence with the cold-sample delivery system. (2) Ozone difluoride, the most powerful oxidizer known, has been synthesized and is to be used to crystallize the operating techniques with the unique cryogenic mass spectrometer. (3) Two molecular beam line-of-sight inlet systems have been designed and constructed for studies of the effluent from pyrolysis experiments. The pyrolysis output gas becomes the cryogenic reactor input gas. (4) Studies were conducted on the preparation of dihalocarbenes. It seems apparent that Cl_2 can be prepared from the pyrolysis of iodoform but not from C_2I_4. CF_2 may apparently be formed from C_2F_4 which in turn may be prepared from Teflon. I.v.L.

N63-23046 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A STUDY OF THRUST VECTOR CONTROL BY LIQUID INJECTION INTO ROCKET NOZZLES
Robert Sehgal and Jain Ming Wu May 1, 1963 39 p 24 refs
(NASA Contract NAS7-100)
(NASA CR-51013; JPL-TM-33-138) OTS: $3.60 ph, $1.37 mf

This paper presents analytical studies of thrust vector control by the injection of a volatile liquid into the expansion cone of a rocket motor. An analytical model is constructed to represent the interaction between the injected liquid and the supersonic stream by considering the mechanism of atomization, the rate of evaporation, and the motion of droplets, based on the injectant and gas properties. From computed body shapes, the nature and criteria of shock waves formed ahead of the injector due to turbulent boundary-layer separation, and the blunt-nose-shaped body due to secondary flow, are investigated. The total side force is computed by calculating the excess pressure occurring on the nozzle wall downstream of the shock pattern, the side-force contribution due to the separated region, and the reaction force due to the momentum of the injected jet. A numerical example is presented, results of which compare favorably with available test data. Author

N63-23378 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE MECHANISM OF FLAME ACCELERATION IN THE TRANSITION FROM NORMAL BURNING TO DETONATION
L. N. Pyatnitskiy Dec. 7, 1962 11 p 10 refs Transl. into ENGLISH from Doklady Akad. Nauk SSSR (Moscow), v. 144, no. 6, 1962 p 1262–1265
(FTD-TT-62-1441/1+2+4)

Attention is given to the processes on which the mechanism of flame acceleration in the transition from normal burning to detonation is based. The phenomena is discussed in detail, and the origin and development of a turbulent boundary was found to cause the acceleration of the flame. This is one of the principal reasons for the appearance of gas pulsations and the increase in the combustion rate per unit of flame surface caused by these pulsations, and also the increase in the flame surface and the formation of relatively weak shock waves, which then accumulate into a shock wave capable of igniting the mixture. C.L.W.

N63-23394 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DEVICE FOR REGULATING AND INTERCEPTING THE SUPPLY OF A FUEL COMPONENT
Yu. V. Belyayev, A. Ye. Golodovskiy et al Aug. 27, 1963 5 p Transl. into ENGLISH from Russian Patent 152151, (Appl. 769862/24-6), Mar. 2, 1962 p 1–3
(FTD-TT-63-850/1+2)

A proposed device for regulating and stopping the flow of a fuel component to, for example, the units of a liquid-fuel rocket engine has a flow valve in the form of a mobile spring-based bushing with gasketing between the bushing and the device casing. This casing is provided with guide ribs in its internal housing. The entire device is mounted in the piping system which has a fitted seat for the spring-based cutoff valve. Sealing is accomplished by uniformly pressed fluoroethylene films which can be destroyed only by the triggering of the pyrotechnic lock. I.v.L.

N63-23418 Magna Corp., Anaheim, Calif. Research and Development Div.
BIOCHEMICAL FUEL CELLS Fourth Quarterly Progress Report, Apr. 1–June 30, 1963
J. M. Brake, W. R. Momyer, and H. P. Silverman [1963] 30 p 11 refs
(Contract DA 36-039-SC-90866)

The ureolytic activity of *B. pasteurii* was investigated as a function of temperature in the range from 25° to 60° C. The temperature for optimum activity was found to be 49° C. The electro-oxidation of hydrogen and ammonia was investigated under conditions compatible with the biological phase. The electrochemical performance of the *B. pasteurii*-urea system was investigated using dispersed suspensions of the bacterium. The performance of this anode was evaluated as a function of temperature and of *B. pasteurii* concentration. Author

N63-23574 Texas A. and M. Research Foundation, College Station
ENVIRONMENTAL POLLUTION BY MISSILE PROPELLANTS [Final Report, Jan. 1962–Nov. 1962]
Walter W. Heck, Morris E. Bloodworth, William J. Clark, Dale R. Darling, and William Hoover Wright-Patterson AFB, Ohio, Biomed. Lab., Aug. 1963 89 p refs
(Contract AF 33(616)-7801)
(AMRL-TDR-63-75) OTS: $2.25

Experimental procedures were developed to study the effects of hydrazine, unsymmetrical dimethylhydrazine (UDMH), pyridine borane, and nitronium perchlorate on plant growth and development, soil and soil structure, and aquatic organisms. Under the conditions used in this study, the four chemicals do not appear to be important environmental contaminants in relation to plant growth and development. Both UDMH and hydrazine are strongly adsorbed or decomposed on clay particles. Montmorillonite and kaolinite clays, as well as the test soils, seem to accelerate the decomposition of the UDMH and hydrazine. Pyridine borane was adsorbed on the test soils but apparently was not adsorbed on the pure clays. The aquatic life was very sensitive to the three organic compounds, and to some extent to the perchlorate ion. Author

N63-23582 Aerospace Medical Div., Wright-Patterson AFB, Ohio Aerospace Medical Research Labs. (6570th)
DETECTION OF MICROBIAL CONTAMINANTS IN JP-4 FUEL
Marilyn E. George Jan. 1963 7 p 1 ref
(AMRL MEMO-M-26)

A qualitative method for the detection of living microorganisms in JP-4 fuel, based on the measurement of CO_2 produced by cellular respiration, is described. This technique has proved successful for the qualitative detection of microorganisms in samples of JP-4 fuel. Attempts have also been made to determine the number of organisms in the fuel which involved determination of total weight or total nitrogen, but these have not proved completely successful. C.L.W.

N63-23602 Southwest Research Inst., San Antonio, Tex.
A PRELIMINARY ANALYSIS FOR OPTIMUM DESIGN OF RING AND PARTITION ANTISLOSH BAFFLES Technical Report No. 7
Carl G. Langner Apr. 30, 1963 81 p refs
(NASA Contract NAS8-1555; SwRI Proj. 6-1072-2)
(NASA CR-52069) OTS: $8.10 ph, $2.63 mf

Presented here is a preliminary analysis of the factors involved in designing a minimum-weight baffle system, composed of rings and/or partitions, to prevent excessive fuel sloshing in the propellant tanks of large rocket vehicles. By specifying over a given frequency range a maximum permissible force response due to liquid sloshing, a set of permitted combinations among the ring and partition baffle structures is determined, each of which sufficiently suppresses the liquid

motion. The overall minimum-weight baffle system is then determined from a strength analysis of the permitted baffle structures. Results of a typical example indicate that for moderate damping a plain ring-baffle system has minimum weight. Author

N63-23677 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE EFFECT OF PROPELLANT SLOSHING ON THE STABILITY OF AN ACCELEROMETER CONTROLLED RIGID SPACE VEHICLE
Helmut F. Bauer Washington, NASA, Oct. 1963 92 p refs (NASA TN D-1831) OTS: $2.25

Very useful results can be obtained from a simplified stability investigation of an accelerometer-controlled rigid space vehicle with respect to propellant sloshing. In this parametric study the liquid was simulated by an equivalent mechanical model consisting either of mass-spring-damper systems or pendulum-damper systems for each sloshing mode, and a non-sloshing mass with a moment of inertia. For simplification, only the propellant sloshing in one tank was considered. The influence of various parameters, such as ratio of sloshing propellant mass to total vehicle mass, natural slosh frequency, control frequency, control damping, gain factors of the attitude control system, accelerometer gain, its natural frequency, damping, and location was investigated. The potential hazard in control due to propellant sloshing in space vehicles can be eliminated by proper choice of tank form (slosh mass ratio decrease and slosh frequency increase), proper selection of characteristics, location and gain value of the accelerometer, and, as a last resort, by baffles in the propellant tanks. Author

N63-23819 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A STUDY OF MASS FLOW MEASUREMENTS USING ORIFICES IN THE IMPULSE BASE FLOW FACILITY
Lorant Pallós [1963] 32 p refs
(NASA TM X-50998; MTP-AERO-63-59) OTS: $3.60 ph, $1.16 mf

This note presents an analysis of the orifice method, both above and below the critical pressure ratio. Discussed are the equations needed to determine the mass flow as a function of the charge tube pressure, the orifice diameter, and flow coefficients, including the orifice static pressure and Mach number function. This study presents some representative charts for oxygen, which can be used to select the orifice for a specified performance, to design a constant pressure combustor. Author

27 PROPULSION

Includes: airbreathing, electric, liquid, nuclear, and solid propulsion.

For related information see: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N63-23151 Brevard Engineering College, Melbourne, Fla.
PRECISION THRUST CONTROL ROCKET ENGINE OPERATING AT CONSTANT CHAMBER PRESSURE
Sebastian J. D'Alli June 1963 43 p 13 refs
(Tech. Rept. 63-2)

A method of varying the thrust of a rocket engine from zero pounds to maximum design value, while maintaining constant combustion-chamber pressure throughout the entire range, is described. The resulting precision thrust-control rocket-engine system makes use of a method involving variable injection area and variable throat area to achieve a variable thrust at constant chamber pressure and at a constant injection-pressure drop, while at the same time providing: (a) positive thrust termination to eliminate thrust tail off, (b) full-design chamber pressure at the nozzle entrance for greater efficiency, (c) true thrust variations which range the full scale from zero to maximum design value, and (d) operation efficiency at near-zero levels with full supersonic flow in the nozzle. I.v.L.

N63-23171 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
THE HYSTERESIS MOTOR
H. E. Jaeschke London, Min. of Aviation, June 1963 51 p 30 refs Transl. into ENGLISH From Elektrotech. Maschinenbau, v. 60 no 17/18–19/20, 1942 p 176–188; 207–216
(RAE Library Translation 1038)

Theory of the hysteresis motor torque is given, and the properties of the ideal hysteretic material are discussed. The hysteresis angle (the phase displacement between H_k and the fundamental component of B_k) is shown to be a measure of the hysteresis torque. The conclusion is reached that to achieve optimum power factor, the hysteresis loop, in addition to having a large area, should have steep sides and the longest possible angle at the tips of the loops between the rising and falling parts of the curve. Design calculations are given for a motor having a mechanical power output of 15 kw, at synchronism (1500 rpm), with a calculated efficiency of 87%. Author

N63-23181 Naval Radiological Defense Lab., San Francisco, Calif.
RADIONUCLIDE RELEASE FROM AERO-SPACE NUCLEAR REACTOR FUELS. I. SAFETY ANALYSIS OF PULSED NEUTRON IRRADIATION OF DRY FUEL
J. L. Mackin and P. E. Zigman Aug. 8, 1963 25 p 12 refs (USNRDL-TR-669)

The safety of in-core exposures of ROVER/NERVA fuel to pulsed neutron irradiation has been analyzed. Exposure in a dry environment of fuel specimens containing one gram of U^{235} to a TRIGA Mark F power transient (following a three-dollar step increase in reactivity) was examined. These examinations indicate that expected temperatures, pressures, and radiation levels are well within required safety limits. Author

N63-23212 Douglas Aircraft Co., Santa Monica, Calif.
ON BOARD PROPULSION DESIGN FOR MANNED SPACECRAFT
J. C. Moule, H. Nitikman, and P. B. Thompson *In* AIAA 2nd Manned Space Flight Meeting [1963] p 81–85 (See N63-23201 24-01)

General requirements and design considerations unique to manned propulsion systems are discussed. These requirements and considerations are as follows: (1) engine requirements with regard to crew safety and reliability; (2) requirements for pilot controls and displays; (3) propellant management requirements; and (4) the possibility of inflight maintenance and repair. I.v.L.

N63-23240 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
STATUS AND FUTURE ENGINEERING PROBLEMS OF ELECTRIC PROPULSION SYSTEMS
Russell D. Shattuck and Robert J. Denington *In* AIAA 2nd Manned Space Flight Meeting [1963] p 341–350 refs (See N63-23201 24-01)

The status and future engineering problems of electric propulsion systems are discussed in the following areas: (1) engine characteristics, (2) thrustors; present status and problems, and (3) status of electric power supplies; power conversion techniques. It is pointed out that in order to design an electric engine system of long-flight capabilities, a multi-pronged research, development, and testing effort of extensive proportions must be completed; systems will have to incorporate redundancy concepts and a tolerance of component failures and may have to be capable of onboard repair and maintenance in flight. The state-of-the-art for small electric thrustors is promising, and, with the possible exception of the lifetime problem, it should not be difficult to extrapolate the present performance to higher power levels. P.V.E.

N63-23364 Radio Corp. of America, Burlington, Mass. Aerospace Communication and Controls Div.
PROGRAM 706, TASK 4. MPU BLADDER DEVELOPMENT Second Quarterly Progress Report [Apr. 1, 1963–June 30, 1963]
S. J. Brzeski et al July 30, 1963 44 p 12 refs
(Contract AF 04(695)-273)
(SSD-TDR-63-183-(IV))

The purpose of this task is to develop a nonmetallic, positive expulsion bladder to be used in space vehicle propulsion systems, utilizing N_2O_4 and a 50-50 blend of UDMH and N_2H_4 as the propellants. Research and tests on materials for nonmetallic positive expulsion bladders have resulted in the selection of a bag-in-bag Teflon-film combination in each bag, for fabrication of a set of 37-in.-diam. bladders to be subjected to a series of expulsion–temperature tests. Full-scale bladder tests have shown that both a bag-in-bag single-layer Teflon-film combination, and a single-bag Teflon-film combination fail during propellant expulsion tests below 70° F. Slosh tests have shown that a single-bag Teflon-film combination bladder is capable of withstanding a typical P706 vehicle mission slosh cycle. Author

N63-23557 Radio Corp. of America, Burlington, Mass.
MPU BLADDER DEVELOPMENT [Final Report]
T. C. Andreopoulos Nov. 4, 1963 211 p refs
(Contract AF 04(695)-273)
(SSD-TDR-63-278)

The purpose of this task was to develop and test a nonmetallic, positive expulsion bladder to be used in space-vehicle propulsion systems utilizing an oxidizer of N_2O_4, and a fuel of a 50-50 blend of N_2H_4/UDMH as the propellants. A material-sample temperature test program and a full-scale bladder, temperature expulsion test program have been completed which resulted in the selection and fabrication of bladders for further slosh and vibration testing. The selected configuration is a "bag-in-bag" type with a TFE/FEP (tetrafluoroethylene/fluorinated ethylene propylene) Teflon film combination in each bag. Slosh tests have shown that a single "bag" Teflon film combination bladder is capable of withstanding a typical P706-vehicle-mission slosh cycle. Author

N62-23558 Princeton U., N.J. Guggenheim Laboratories for the Aerospace Propulsion Sciences
AN OPTICAL METHOD FOR OBSERVING BREAKUP AND VAPORIZATION OF LIQUID JETS
W. R. Seebaugh and D. H. Lee June 1963 101 p 32 refs
(NASA Grant NsG-99-60)
(NASA CR-52081; Aeronautical Eng. Rept. 647) OTS: $9.10 ph, $3.23 mf

An optical method for observing and analyzing the breakup and vaporization of liquid jets was developed. Schlieren and shadow photographs are presented to illustrate the effects of varying the relative knife-edge cutoff, focusing, film position, and exposure duration. Shadow photographs of fully developed, turbulent flow jets employing several liquids including water, ethyl aclohol, dichlorofluoromethane (Freon-21), liquid oxygen and dichlorodifluoromethane (Freon-12) are presented and analyzed. Application of the data obtained to combustion instability research is discussed. Author

N63-23564 Virginia U., Charlottesville
BIBLIOGRAPHY OF SQUID PUBLICATIONS JUNE 1961-SEPTEMBER 1963 [Supplement 4, June 1, 1961-Sept. 30, 1963]
Oct. 1963 76 p 75 refs
(Contract Nonr-3623(00))
(UVA-3-R)

Abstracts are listed in a bibliography concerning the transport and structural properties of gases, liquids, and solids; physical processes, such as heat and mass transfer, fluid flow, and mathematical physics; chemical processes, such as reaction kinetics, thermodynamics, and thermochemistry; combustion phenomena, such as ignition, flame propagation rate, flame structure and stability, and flame spectra and radiation; engines and propulsion systems; and instrumentation, such as temperature and pressure measurement. C.L.W.

N63-23741 Naval Ordnance Lab., White Oak, Md.
HIGH TEMPERATURE RESISTANT MATERIALS FOR MISSILE PROPULSION SYSTEMS Summary Report, June 30, 1961–June 30, 1962
F. J. Koubek Jan. 30, 1963 42 p refs
(NOLTR 63-3)

Oxyacetylene torch test studies on a series of experimental phenolic resins are described along with those conducted on a number of commercial ablation type materials. A phenolic-polyamide copolymer was found to be the most effective for insulation effectiveness. The potential of silicone rubber as the matrix for an effective elastomeric insulator was demonstrated. A thermal insulation study program, designed to gain an experimentally supported understanding of ablation mechanisms, is described. Efforts have been presently directed toward further refinement of the "alpha-rod" test technique and investigating the requirements for a plasma arc driven environmental simulator. Author

N63-23749 National Aeronautics and Space Administration, Washington, D.C.
HYDROGEN-OXYGEN FOR ROCKET PROPULSION
John L. Sloop N.Y., Am. Inst. of Aeron. and Astronautics [1963] 18 p Presented at the AIAA/CASI/RAeS 9th Anglo-Am. Conf., Cambridge, Mass., Oct. 16–18, 1963 and Montreal, Canada, Oct. 21–24
(AIAA Paper 63-475) AIAA: $0.50 members, $1.00 nonmembers

The following areas in the technology of hydrogen—oxygen propulsion systems and power-generation systems using hydrogen and oxygen are discussed: (1) fluid mechanics of hydrogen—materials and insulation; (2) propellant pressurization and expulsion; (3) effects of zero gravity; (4) pumps; (5) thrust chambers; (6) combustion oscillations; (7) throttling; and (8) hydrogen–oxygen for electric power. P.V.E.

N63-23763 Curtiss-Wright Corp., Wood-Ridge, N.J. Wright Aeronautical Div.
SUPERSONIC TRANSPORT PROPULSION SYSTEM CONTINUED RESEARCH AND STUDY OF HIGH TEMPERATURE TURBINE AND EXHAUST NOZZLE NOISE. VOLUME II: EXHAUST NOZZLE NOISE PROGRAM First Quarter Progress Report, Apr. 15-July 15, 1963

Wright-Patterson AFB, Ohio, Aeron. Systems Div. Aug. 15, 1963 23 p refs
(Contract AF 33(657)-9058)
(SQ-I-II)

The principal accomplishments discussed include: the aero/acoustical design of new concepts for noise suppression, and the aerodynamic design of internal contours for a C-D (convergent-divergent) plug-type nozzle. Author

N63-23764 Curtiss-Wright Corp., Wood-Ridge, N.J. Wright Aeronautical Div.
SUPERSONIC TRANSPORT PROPULSION SYSTEM COMPONENT RESEARCH AND STUDY PROGRAM EXHAUST SYSTEM NOISE CRITERIA. VOLUME II: PROGRAM AREA – 920K [Final Report, May 23, 1962-May 23, 1963]
C. J. Callahan, J. Papazian, and R. Buyer Wright-Patterson AFB, Ohio, Propulsion Lab. Aug. 1963 182 p refs
(Contract AF 33(657)-9058)
(WAD Ser. Rept. SST:00-277)

With the objective of achieving sizable noise suppression while maintaining high thrust performance, a systematic experimental investigation of plug-type exhaust nozzles suitable for the supersonic transport aircraft has been conducted. Small-scale nozzle models were employed, and cold-flow testing was conducted on an open-field noise test facility, and on separate static and transonic thrust facilities. From the results of the investigation, it is concluded that: (1) the annular geometry of the plug nozzle, in itself, provides a significant advantage in reducing the far-field noise of supercritical jets, and (2) additional noise reductions are not sufficiently large to justify serious consideration of concentric flow staging vanes in a full-scale engine, even though the associated thrust penalties would be insignificant. Author

N63-23765 Curtiss-Wright Corp., Wood-Ridge, N.J. Wright Aeronautical Div.
SUPERSONIC TRANSPORT PROPULSION SYSTEM COMPONENT RESEARCH AND STUDY PROGRAM AUXILIARY POWER EXTRACTION. VOLUME III: PROGRAM AREA – 920K [Final Report, May 23, 1962-May 23, 1963]
R. A. Crocco, H. W. Weiser, and P. Fisch Wright-Patterson AFB, Ohio, Propulsion Lab., Aug. 1963 263 p refs
(Contract AF 33(657)-9058)
(WAD Ser. Rept. SST:00-277)

A systematic analysis is presented which examines four gas-turbine engine types sized for the critical flight condition. Performance of each engine has been calculated at discrete flight conditions to provide a parametric analysis of the effects of power extraction (direct power takeoff and air bleed) on engine thrust output and specific fuel consumption. Based on performance comparisons obtained, the nonaugmented turbojet was selected for further aircraft range studies with two power distribution systems. A representative aircraft was selected to establish the framework for the analysis of two power (generation and distribution) systems. The two systems are (1) direct power takeoff with hydraulic and electrical distribution, and (2) air-bleed extraction utilizing air-turbine conversion with hydraulic, pneumatic, and electrical distribution. Author

28 SPACE RADIATION

Includes: cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts.

For related information see: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N63-23060 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN INTERIM INTERSTELLAR RADIATION FIELD
T. P. Stecher and J. E. Milligan Washington, NASA Repr. from Ann. Astrophys. (Paris) v. 25, no. 4, July–Aug. 1962 p 268-270 9 refs
(NASA RP-106)

Stellar observations in the ultraviolet, made from rockets, are in serious disagreement with the predictions of model atmospheres. The general form that the interstellar radiation field will take when more observations are available is indicated. Author

N63-23163 Alaska U., College Geophysical Inst.
THE ANOMALOUS ENTRY OF LOW-RIGIDITY SOLAR COSMIC RAYS INTO THE GEOMAGNETIC FIELD
S.-I. Akasofu, W. C. Lin and J. A. Van Allen (Iowa State U.) Repr. from J. Geophys. Res., v. 68, no. 19, Oct. 1, 1963 p 5327–5338 50 refs
(NASA Grants NsG-201-62 and NsG-233-62; Contract N9onr-93803)

It is shown that the observed arrival of low-rigidity solar cosmic rays at latitudes much below those predicted by the Störmer theory for the dipole field of the earth cannot be explained, either by a physically plausible ring current or by any experimentally established limitation of the radial extent of the magnetosphere, if either perturbation is acting alone. It is then demonstrated by an approximate theoretical treatment that the observed reductions of geomagnetic cutoffs can be explained plausibly and quantitatively as due to the combined effects of these two perturbations. The present study has been limited to the noon meridian. Author

N63-23166 Iowa State U., Iowa City
LATITUDE SURVEY OF COSMIC-RAY INTENSITY BY EXPLORER 7, OCTOBER 1959 TO FEBRUARY 1961
W. C. Lin, D. Venkatesan, and J. A. Van Allen Repr. from J. Geophys. Res., v. 68, no. 17, Sept. 1, 1963 p 4885–4896
(NASA Grant NsG-233-62; Contract N9onr-93803)

Using a shielded Geiger tube in the Explorer 7 satellite, a comprehensive geographic survey of the intensity of charged particles in the latitude range ±50.5°, in the altitude range 550 to 1100 km, and over a 16-month period, has been conducted. It has been found possible to identify and eliminate contributions by geomagnetically trapped particles and thus to obtain the sum of the absolute intensities of primary galactic cosmic rays and of their charged-particle secondaries (albedo) produced in the atmosphere. Specific results are given. Author

N63-23218 Aerospace Medical Center, School of Aerospace Medicine, Brooks AFB, Tex.
A REAPPRAISAL OF THE RADIATION HAZARDS TO MANNED SPACE FLIGHT
John E. Pickering and John M. Talbot *In* AIAA 2nd Manned Space Flight Meeting [1963] p 120–125 refs (See N63-23201 24-01)

Radiation hazards to manned spaceflight are reviewed. For energies less than 10 Mev, in view of the shielding required for more energetic particles, extremely intense incident fluxes of this lower energy radiation are necessary before they would constitute a problem. From 10 to approximately 300 Mev, if the shield is designed to stop the primaries up to a given energy, secondaries will be taken care of more or less automatically. From 300 Mev to 1 Bev, the range of the mesons is fairly small and, again, shielding designed to stop the primary radiation will, to a large degree, stop the secondary radiations. Composite shielding might be preferable for

an energy range above 1 Bev. At very high energies (above 10 Bev), the buildup of secondaries and further generations contribute predominantly to ionization and dose, and the best philosophy may be to use no shielding at all, unless the primary flux is very strong, as in the case of a solar flare. I.v.L.

N63-23225 Martin-Marietta Corp., Baltimore, Md. Space Systems Div.
RADIATION SHIELDING CONSIDERATIONS IN MANNED SPACECRAFT DESIGN
S.L. Russak *In* AIAA 2nd Manned Space Flight Meeting [1963] p 187-194 refs (See N63-23201 24-01)

The consideration of radiation shielding requirements is achieved "bootstrap" fashion in a series of feedback analyses. Inputs from various technical specialty areas, such as flight mechanics, structures, and configuration design, are used to help define the radiation hazard. The radiation analysis, in turn, furnishes data to these specialty areas, and these data are used to make modifications which will reduce the radiation dosages without adverse functional or operational effects. Even a small amount of radiation shielding saved by the relocation of an already existing component is well worth the effort. In this regard, all the components of the spacecraft may be thought of as a part of the radiation shield "subsystem." This subsystem is then designed, along with other subsystems so that specific shielding mass is kept to minimum. I.v.L.

N63-23402 Douglas Aircraft Co., Santa Monica, Calif. Missile and Space Systems Div.
CORPUSCULAR RADIATION PRODUCED CRYSTALLINE DAMAGE AT THE LUNAR SURFACE
J. A. Ryan May 1963 46 p refs Presented to the Lunar Surface Materials Conf., Boston May 22, 1963 Submitted for Publication
(Engineering Paper No. 1632)

The corpuscular radiation flux incident upon the lunar surface, the dissipation of the energy contained in this flux with depth below the surface, and the effects of this upon the crystalline structure of the lunar material are considered. The major contributors to the corpuscular radiation flux at the lunar surface are the solar and galactic particles. Assuming that a static condition exists at the lunar surface, the following conclusions are presented: (1) no significant radiation-produced crystalline damage has occurred below a depth of about 2 g cm^{-2}, (2) in the depth range 1 to 2 g cm^{-2}, significant damage could occur, but it appears that this could not be great enough to completely disrupt the crystalline structure; (3) in the depth range 0 to 1 g cm^{-2}, it is possible that metamictization could occur. R.T.K.

N63-23447 Iowa State U., Iowa City
THE EARTH AND NEAR SPACE
James A. Van Allen *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8-May 21, 1962 p 173-191 (See N63-23436 24-01)
(Lecture 12)

The current state of observation and understanding of the corpuscular radiations in near space is reviewed. The contributions of rockets, balloons, radio techniques, high altitude nuclear detonations, and, especially, satellites to the discovery and understanding of trapped radiation are discussed. Tentative answers are given for problems relating to: (1) the intensity structure of the trapped radiation; (2) the influence of magnetic forces on fluctuations in intensity in the inner zone; (3) the influence of solar flares and geomagnetic storms on outer zone intensity fluctuations; (4) the geographic, spatial, and time distributions of these fluctuations; (5) the geophysical effects of the trapped particles; and (6) the source of the trapped radiation in each zone. Further observations are required before the answers given can be considered definitive, especially in regard to the relationships of the trapped radiation to geophysical phenomena and to the interplanetary plasma. M.P.G.

N63-23635 Air Force Systems Command Wright-Patterson AFB, Ohio Foreign Tech. Div.
THE DOUBLE ELECTRICAL LAYER AT THE SURFACE OF A SATELLITE
M. A. Gintsburg Jan. 2, 1963 25 p refs Transl. into ENGLISH from Trudy, Inst. Zemnogo Magnetizma Ionosfery i Rasprostraneniya Radiovoln i Ionosfera (Moscow), Acad. Sci. USSR, 1960 Issue 17(27)
(FTD-TT-62-1380/1+2+4)

Three equations are discussed which describe the distribution of the electric field in the double electrical layer formed about the surface of a satellite in the ionosphere. The differences between these three theories are indicated briefly, and the results obtained when they are applied to a concrete problem of a satellite in the ionosphere are presented. The following areas, in particular, concerning the double electrical layer are discussed: (1) the double layer in thermodynamic equilibrium, (2) the Langmuir-Bohm equation, (3) the double layer at equilibrium ion concentrations, and (4) the influence of the magnetic field. P.V.E.

N63-23659 Stanford U., Calif. Radioscience Lab.
SYNCHROTRON EMISSION AS THE SOURCE OF VHF AURORAL NOISE. SUPPLEMENT TO SYNCHROTRON EMISSION FROM HIGH-ENERGY ELECTRONS Technical Report No. 1403-1 (Sup) and Scientific Report No. 1 (Sup)
Glen L. Hower May 1963 90 p refs
(Contract AF 19(604)-7994)
(SEL-62-149(SUP))

The necessary energies and densities of auroral electrons are estimated using the computational techniques presented previously. Although direct measurements of high-energy auroral electrons during severe disturbances are not available for comparison, the estimates indicate that the synchrotron mechanism offers a probable explanation for past observations of vhf auroral noise at midlatitude stations. An experimental program is outlined which could provide information on the mechanism of auroral noise generation, and the relationships between auroral noise events and other geophysical phenomena. Author

N63-23664 Lincoln Lab., Mass. Inst. of Tech., Lexington
STUDIES OF THE F-REGION BY THE INCOHERENT BACKSCATTER METHOD
J. V. Evans July 24, 1962 64 p refs
(Contract AF 19(628)-500)
(Tech. Rept. 274)

Measurements have been made of the distribution of electrons in the F-region of the ionosphere by observing the weak incoherent backscatter signal. The distribution of electrons above the peak of the F-region has been a subject of special study. On the basis of the results obtained to date, the conclusions reached are: (1) the scale height of the electron density increases with height, (2) the ion temperature is not very dependent on height, though it does show a marked diurnal variation, (3) the electron-to-ion temperature ratio is 1:1 during the hours of darkness, but during the daytime it increases to a peak value ~1.6:1 around noon, and (4) the scattering cross section for the electrons is close to the expected value when allowance is made for (3). Author

N63-23779 Battelle Memorial Inst., Columbus, Ohio Radiation Effects Information Center
REPORT ON SPACE-RADIATION DAMAGE TO ELECTRONIC COMPONENTS AND MATERIALS
W. E. Chapin, D. J. Hamman, E. N. Wyler, and D. Jones Oct. 30, 1963 67 p 41 refs
(Contract AF 33(657)-10085)
(REIC-32)

Most of the investigations are concerned with radiation effects on such semiconductor devices as solar cells, solid-state diodes, and transistors. A limited amount of experimentation has been conducted for other commonly used electronic components because gamma- and neutron-radiation data indicate that they do not present problems comparable to solid-state devices. Metals are also discussed. Some discussion concerning shielding is included. Author

N63-23785 Army Signal Research and Development Lab., Fort Monmouth, N.J.
SOLAR AND SKY ULTRAVIOLET MEASURING AND RECORDING EQUIPMENT
R. M. Marchgraber and R. W. Armstrong July 1962 51 p 24 refs
(USASRDL-TR-2290)

A description is given of the development and performance of instrumentation for the continuous measurement of solar and sky ultraviolet radiation as received on a horizontal surface from sun and sky (pyranometer), as well as in normal incidence from the sun (pyrheliometer). Sources of errors such as change in air mass (filter-weighting factor) and environment (transient response) are discussed, and areas of needed improvement are indicated. Author

29 SPACE SCIENCES

Includes: space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories.

For space biology see: 16 Life Sciences.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N63-23020 National Aeronautics and Space Administration, Washington, D.C.
THE U.S. SPACE PROGRAM PROGRESS REPORT
Hugh L. Dryden [1962] 10 p Presented at Space Sci. Commemorative Dinner, Cleveland, Ohio, Nov. 25, 1962
(NASA TM X-50963) OTS: $1.10 ph, $0.80 mf

NASA accomplishments over the past four years are outlined. Much detailed information of the composition of the Earth's "atmosphere" has been gained. The first layer extends to about 75 miles, and is composed chiefly of oxygen and nitrogen; the second layer extends from about 75 miles to about 620 miles, and is composed essentially of atomic oxygen; the third layer which extends from about 620 miles to 1500 miles is composed chiefly of helium. Above this layer is the hydrogen layer fading out into interplanetary space. The major outline of the density of the atmosphere at various heights and its variation with time of day and with solar activity have been determined. Radio soundings of the ionosphere are being made. Measurements of protons and electrons in the region around the Earth are being made. The main features of the Earth's magnetic field have been determined. The moving Earth produces a magnetic shock wave in the interplanetary field. Behind the shock wave is a region of transition to the Earth's field exhibiting irregular variations in magnitude and direction. The first probe to Venus is on the way, due to reach the neighborhood of the planet in mid-December. Tiros weather satellites are sending meteorological data, and Echo and Telstar are providing transoceanic communications. The development of an advanced Saturn is underway. Project Mercury was successful. Projects Gemini and Apollo are in the development stages. I.v.L.

N63-23035 General Mills, Inc., Minneapolis, Minn. Electronics Div.
MICROSCOPIC SYSTEM FOR MARS STUDY PROGRAM Summary Report, Preliminary Experimental Design Study
V. W. Greene, D. A. Lundgren, D. D. Mullin, and R. E. Peterson Aug. 30, 1962 29 p
(NASA Contract NAS7-100; JPL Contract 950123; Proj. 89268)
(NASA CR-51538; Rept. 2326) OTS: $2.60 ph, $1.07 mf

Preliminary results of experimental exploration into design concepts for the Mars microscope system have demonstrated the feasibility of pneumatic sampling techniques for collecting aerosolized surface particles. Mass sampling rates on the order of 100 mg/min have been achieved over representative soil substrates with an average power consumption, extrapolated to an equivalent Martian collecting condition, of 3 to 4 watts. Sample processing investigations were directed toward using density fractionation methods for segregating the microorganic constituents from the inert mineral background, and concentrating this biological fraction into a small volume of liquid to facilitate the further processing required for microscopic analysis. P.V.E.

N63-23036 Alaska U., College Geophysical Inst.
NEGATIVE CORRELATION BETWEEN POLAR CAP VISUAL AURORA AND MAGNETIC ACTIVITY
T. N. Davis [1963] 24 p 10 refs
(NASA TM X-50782) OTS: $2.60 ph, $0.92 mf

An investigation has been made of the relationship between the local (K) and planetary (K_p) magnetic activity and the occurrence of visual auroras inside the auroral zone. It is found that the visual aurora above geomagnetic latitude 80° is negatively correlated with the K and K_p magnetic indices, whereas nearer to the auroral zone the correlation is positive. The relationship in the region 75° to 80° latitude is more complicated and of a transitional nature. Author

N63-23048 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE DETECTION OF WATER VAPOR ON MARS
Hyron Spinrad, Guido Münch, and Lewis D. Kaplan May 1963 4 p Repr. from the Astrophys. J., v. 137, no. 4, May 15, 1963 p 1319–1321
(NASA Contract NAS7-100)
(JPL-TR-32-454)

Eleven weak lines of water vapor were found on a high-dispersion near-infrared spectrogram of Mars taken at the coudé focus of the Mount Wilson 100-inch reflector on April 12–13, 1963. The Martian H_2O lines in the λ 8200 water-vapor band were displaced 0.42 A longward of their telluric counterparts due to the relative velocities of the Earth and Mars: $\Delta V = +15$ km/sec on that date. The Martian lines were strongest over the poles of the planet. The spectrograph slit was set almost north-south to cover both polar regions. This apparent polar strengthening of the Martian H_2O lines is at least partially due to the increased air mass through the line-of-sight to high altitudes. The Martian H_2O lines have

strengths of approximately 3 to 5 mA; but for such faint lines, east-west measurements are uncertain. Preliminary examination of the data indicates that the Martian H_2O abundance is probably near 5 to 10μ precipitable H_2O over the Martian poles. Also, the 5_{ν_3} band of CO_2 at λ 8689 was found in the Martian spectrum. The absorption lines in the R and P branches were well resolved, but they were extremely weak. The head of the 7820 ($\nu_1 + 5\nu_3$) CO_2 band was also visible. The detection of these lines implies a high CO_2 abundance on Mars. I.v.L.

N63-23077 Naval Research Lab., Washington, D.C.
THE E. O. HULBURT CENTER FOR SPACE RESEARCH AT THE U.S. NAVAL RESEARCH LABORATORY, WASHINGTON, D.C.
[1963] 25 p

Research conducted at the E. O. Hulbert Center for Space Research is summarized. Rocket and satellite astronomy studies include solar spectroscopy, solar-disk images, white light corona, fluorescence of the geocorona and interplanetary gas, stellar ultraviolet emission, stellar spectroscopy from small satellites, stellar X-ray astronomy, lunar and planetary albedos, airglow and aurorae, atmospheric composition, and instrumentation for NASA geophysical observatories. Supporting laboratory research in spectroscopy and radioastronomy is also reported. M.P.G.

N63-23124 National Aeronautics and Space Administration, Washington, D.C.
METEOROID EFFECTS ON SPACE EXPLORATION
Maurice Dubin Oct. 1963 18 p 34 refs Presented at the IAS Natl. Meeting on Manned Space Flight, St. Louis, Mo., Apr. 30–May 2, 1962 Submitted for Publication
(NASA TN D-1839) OTS: $0.50

Available information concerning meteoroids and cosmic dust obtained from ground-based observations and satellite measurements is reviewed. These data are presently limited to meteoroids and cosmic dust with heliocentric orbits intersecting the plane of the ecliptic at 1 au and interacting with the earth–moon system. From such information, the expectation of the number of impacts with interplanetary matter as a function of exposed spacecraft surface area exposure time, and meteoroid mass is presented. An estimate of the hazard has been made using appropriate hypervelocity cratering criteria. Author

N63-23128 General Dynamics/Astronautics, San Diego, Calif.
SPACE VEHICLE VULNERABILITY TO METEOROIDS
Ahmin Ali June 30, 1963 66 p 43 refs
(ERR-AN-167)

Theories and experimental data on impact penetration at high projectile velocities have been evaluated. The targets considered include thick and thin single sheets of various materials, as well as multiple, spaced, thin sheets. By the statistical use of the information on meteoroids and the judicious use of penetration data, it is possible to design for protection against the meteoroid hazard. Curves are presented for the required total thicknesses of spaced multiple-sheet aluminum skins for vehicles of varying surface area and mission time. Author

N63-23149 RAND Corp., Santa Monica, Calif.
ON THE USE OF THE CALCULUS OF VARIATIONS IN TRAJECTORY OPTIMIZATION PROBLEMS
D. G. Stechert Oct. 1963 71 p 12 refs
(Contract AF 49(638)-700; Project RAND)
(RM-3793-PR)

Applications of the theory of the calculus of variations to a number of problems are given. These include that of a damped harmonic oscillator that is to be brought to rest in the shortest possible time. In the problem of the trajectory in a constant gravity field, the range from launch to impact is to be maximized, although the formulation would be similar if the initial mass were to be minimized, or the burnout mass were to be maximized. Final mass is to be maximized in the escape trajectory problem. The vertical trajectory problem is included for demonstrating the requirement for a variable-thrust subarc. The close relationship between the ballistic perturbation theory and the calculus of variations is explained. Author

N63-23220 Radio Corp. of America, Camden, N.J.
A STUDY OF CERTAIN ASPECTS OF LUNAR ASCENT AND RENDEZVOUS WITH AN ORBITING VEHICLE
H. U. Burri *In* AIAA 2nd Manned Space Flight Meeting [1963] p 134–139 refs (See N63-23201 24-01)

A linearization of the equations of motion in a curvilinear system of coordinates is described whose origin also moves at orbital rate on a circular reference orbit. In this case the relative motion is restricted only to the vicinity of the reference orbit and not necessarily to the vicinity of the moving origin. The resulting equations are used to study the lunar launch and ascent phase of the lunar orbit rendezvous mission. In planning this maneuver, a nominal ascent plan will have been decided which will require that the first vehicle be launched at a precise moment in order to achieve the rendezvous. Also, limitations placed on deviations from the nominal ascent plan are discussed. I.v.L.

N63-23242 Defense Dept., Washington, D.C. Office of the Director of Defense Res. and Engineering
THE RELIABILITY ASPECTS OF SPACE PROGRAMS
James M. Bridges *In* AIAA 2nd Manned Space Flight Meeting [1963] p 360–363 (See N63-23201 24-01)

In reviewing the more significant aspects of management and technology involved in obtaining reliable space systems, the following statements are elucidated: (1) the fundamental limitation on space systems reliability is the relatively high failure rate of parts now available to the system designer; (2) giving too little attention to reliability during the design, engineering and test of a system have been a major source of operational failures; (3) when first planning a space program, the Government must very carefully determine the minimum level of reliability essential to meet the mission objectives; (4) another concept that could help toward making space systems perform reliably involves the greater usage of common devices or subsystems whose reliability is well known; and (5) the introduction of new components or techniques into a system development before their reliability and performance have been firmly established is a prime source of system operational unreliability. P.V.E.

N63-23311 Air Force Cambridge Research Labs., Bedford, Mass.
A STATISTICAL APPROACH TO LUNAR GEOMETRY
Donald H. Eckhardt (Arizona U.) and Mahlon S. Hunt *In* its Compendium of Papers in the Fields of Geodesy and Planetary Geometry Aug. 1963 23 p refs Presented at IAU Symp. No. 14 on the Moon, Leningrad, Dec. 1960, and revised in Dec. 1962 (See N63-23301 24-01)

Selenographers have been compiling maps of the moon for many years. However, their inputs have relied substantially on parameters gained from applications of the physical theory of the moon and straightforward geometry. Recently, through

selenodetic photogrammetry, approaches utilizing statistical least squares theory have been introduced as possible approaches to the problem. This paper defines one statistical approach through an application of the method of maximum likelihood, and makes a simple pilot error analysis. Author

N63-23341 Douglas Aircraft Co., Santa Monica, Calif. Missile and Space Systems Div.
LUNAR MISCELLANY
J. A. Ryan Apr. 1963 40 p refs
(SM-43544)

Lunar temperatures and their implications as to the nature of the lunar surface and lunar-surface radioactivity are reviewed. The maximum lunar-surface temperature appears to be 400° K, though there is some uncertainty as to this. This maximum temperature occurs roughly at lunar noon, and probably at or near the lunar equator. During the lunar night, the surface temperature drops to a low value, possibly in the neighborhood of 120° K, but quite conceivably somewhat higher or significantly lower than this. The rapid surface-temperature changes with insolation changes indicate strongly, but do not prove, that the surface material has a very low conductivity. The best candidate for explaining this low conductivity appears to be a fine-grained granular material. An unshielded man at the lunar surface would probably receive a gamma dose of less than 6 rad for an exposure of one year. Also, grain-, soil-, density-, and engineering behavior-parameters of lunar soil are discussed. It is indicated that, for a given mass, the ultimate load-bearing capacity of lunar soil is independent of the gravitational force; however, for a given load, the lunar soil has a smaller bearing capacity (smaller by a factor of six) than the terrestrial soil. I.v.L.

N63-23440 Naval Research Lab., Washington, D.C.
SUN AND EARTH
Herbert Friedman *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 67–82 (See N63-23436 24-01)
(Lecture 5)

One aspect of solar-terrestrial relationships, the role of solar ultraviolet and X-ray radiation in the production and control of the atmosphere, is discussed. The possible relationship between solar weather and tropospheric weather, and the straightforward relationship between solar weather, ionospheric density, and the quality of radio reception are considered. Current knowledge of the quiet solar disk and solar corona, based on rocket and satellite spectroscopy, is reviewed, and the catastrophic changes associated with solar flares are discussed. These changes are only imperfectly understood at present, but advances in X-ray telescopes and space stabilized platforms should reveal fine details of the development of solar flares and the movement of hot solar plasmas. M.P.G.

N63-23446 Princeton U., N.J. Palmer Physical Lab.
GRAVITATION AND SPACE SCIENCE
Robert H. Dicke *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 159–171 (See N63-23436 24-01)
(Lecture 11)

The theory is presented that gravitational interaction has been growing steadily weaker with time, due to the general expansion of the universe with time. This theory admittedly is not in accord with Einstein's theory of relativity, which is basic to much recent thought in geology, astronomy, and physics. Therefore, the implications of an alternate theory affect many branches of science. A series of experiments are proposed to provide an observational basis for resolving these differences. These include the use of artificial satellites and planets, the accurate determination of the time-keeping qualities of the moon in orbit related to the time-keeping of the earth rotating on its axis, the placing of a rapidly spinning top in orbit and observation of the orientation of its spin axis, and the determination of the age of the sun from the relative amounts of helium and hydrogen in its atmosphere. The possible effects of a time-varying gravitational interaction on the past history of the planets, stars, and galaxy are considered. These include gradual expansion of the earth and moon, a hotter sun at the time when life evolved on the earth, and a more rapid evolution of stars which would mean that our galaxy is much younger than its apparent age. M.P.G.

N63-23448 Chicago U., Ill. Enrico Fermi Inst. for Nuclear Studies
THE INTERPLANETARY MEDIUM
John A. Simpson *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 193–205 (See N63-23436 24-01)
(Lecture 13)

The contribution of space vehicles to knowledge about the interplanetary medium and the processes which take place in it is discussed. The deep space probe, Pioneer V, produced evidence that the intensity of galactic cosmic rays is decreased throughout the entire inner solar system. Magnetic fields, associated either with the sun itself or with the streaming solar plasma, interact with the oncoming galactic cosmic ray particles, deflecting them in such a way that there is a net decrease in intensity close to sun at maximum solar activity. This effect diminishes with decreasing solar activity so that at solar minimum most of the galactic cosmic rays reach the earth. Explorer X detected an outward flow of gas from the sun whose velocity increased with solar activity but whose density was much lower than predicted. The interplanetary magnetic field, whose lines of force extend outward from the sun, was also detected. The effect of the shock waves produced by solar flares on the geomagnetic field and subsequently on the particles in the radiation belt is discussed. The availability of more advanced space vehicles provides opportunities for further extending this primitive knowledge of the electrodynamics of the interplanetary medium. M.P.G.

N63-23449 Texas U., Austin
EXPLORATION OF THE NEARER PLANETS
Gerard de Vaucouleurs *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 221–237 (See N63-23436 24-01)
(Lecture 15)

Reasons for exploring the nearer planets are discussed, and a rational program of unmanned experimentation of increasing sophistication leading eventually to manned planetary exploration is outlined. The reasons of special interest to individual scientific disciplines are considered to be incorporated into two transcendent goals: the discovery of clues to the origin, mode of formation, and prehistory of the solar system; and the scientific and philosophical significance of the possible discovery of extraterrestrial forms of life. Currently available information about Mercury, Venus, and Mars is reviewed. The orderly use of Earth-based observatories, stratospheric balloons, artificial earth satellites, fly-by space probes, and spacecraft which will go into controllable, closed orbits about the planets and serve as platforms for the launching of planetary atmospheric probes, hard-landing instrument packages, and eventually of soft-landing mobile equipment is considered to provide a solid foundation for a well-rounded program of exploration. M.P.G.

N63-23450 Harvard Coll. Observatory, Cambridge, Mass.
THE SUN
Leo Goldberg *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 239–252 (See N63-23436 24-01)
(Lecture 16)

The goals and accomplishments of solar physics are reviewed. The immediate goal of solar astronomers is to assemble a complete picture of the nature and structure of the sun by interpreting observations of its radiation in terms of physical theory. Such a picture is essential to studies of stellar evolution, the solar system, and solar-terrestrial relationships. At present, not enough is known about the behavior of hot, magnetized gases to interpret all the observations which have been made, and observation itself has been hindered by the opacity of the gases enveloping the sun and by the interference of the earth's atmosphere. The latter limitation is being overcome by high-altitude rockets, balloons, satellites, and space probes. The influences which have been drawn about the solar structure from its mass, brightness, radius, chemical composition, and stability are reviewed, and the processes associated with granulation, solar flares, and the solar cycle are discussed. The proposed launching of orbiting solar observatory satellites is seen as stimulating, rather than replacing, new ground-based observations. M.P.G.

N63-23524 RAND Corp., Santa Monica, Calif.
MAGNETIC FIELD OF THE EARTH AND PLANETS
J. W. Kern and E. H. Vestine Repr. from Space Sci. Rev. (Dordrecht), v. 2, 1963 p 136–171 144 refs
(NASA Contract NASr-21(05))

Knowledge of geomagnetism and its effects was recently much augmented during the IGY; when added to what is known of stellar fields, interplanetary fields, and meteoric magnetism, and combined with magnetic theory, this knowledge not only suggests that much may be learned of our neighbors in space by making an early determination of their magnetic fields, but also provides a foundation for many inferences and rough estimates on the magnetic fields of other solar-system bodies. Present estimates range from 660 cgs for Jupiter to 0.004 for the smaller satellites and the planetoids. Author

N63-23620 California U., La Jolla
THE LIGHT-DARK STRUCTURE IN THE PANTAR AND KAPOETA STONE METEORITES
Kurt Fredriksson and Klaus Keil Repr. from Geochim. Cosmochim. Acta, v. 27, 1963 p 717–739 Presented before the Ann. Meeting of the Mineral. Soc. of Am., Nov. 14, 1962, Houston, Tex.
(NASA Grants NsG-317-63 and NsG 322-63)

Some stone meteorites with a typical light–dark structure contain primordial noble gases in their dark portion exclusively. The minerals and the textures of both light and dark portions in the Pantar chondrite and the Kapoeta achondrite were examined microscopically. The chemical composition of numerous grains of olivine, pyroxene, feldspar, nickel-iron, and troilite was determined using electron microprobe techniques. It was found that both light and dark material in a given meteorite consist of the same minerals with identical composition, but the two portions differ markedly with regard to grain size. Generally, minerals in the dark portions are fine-grained, while the light material has "normal" texture and grain size. The distribution of rare gases is tentatively ascribed to selective trapping in some recrystallized minerals, which have been altered by shockwaves, in the dark part. Author

N63-23694 Lockheed Missiles and Space Co., Sunnyvale, Calif.
METEOROID EFFECTS ON NUCLEAR ROCKET SPACE VEHICLE MISSION SUCCESS
William H. Sterbentz and Loren L. Long May 1, 1963 32 p refs Presented at the 6th Hypervelocity Impact Symp., Cleveland, Apr. 30–May 2, 1963
(LMSC-A303806; NSP-63-49)

The probability of failure to complete a lunar mission is negligible for an unprotected nuclear rocket wherein the nuclear stage is used only to accelerate the payload spacecraft to the desired earth-lunar transfer velocity. However, if such an unprotected nuclear rocket of 250,000-lb liquid-hydrogen capacity is also used to retrofire the payload into lunar orbit, there is a 2% probability of failure to successfully complete the mission. In the case of the same-sized nuclear orbital-transfer vehicle, the probability of an unprotected vehicle failing due to meteoroid damage during a single 15-day mission is about 10% and is a virtual certainty to fail to achieve a desired lifetime of 30 to 50 missions. A shield of 0.02-inch aluminum around the liquid-hydrogen propellant tank reduces the probability of failure to less than 0.5% for a single mission for both the lunar and orbital mission vehicles. However, for the orbital transfer vehicle, the shield thickness should be increased to about 0.20 inch, and this increased protection results in long vehicle lifetime and maximum lifetime payload. Author

N63-23708 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A THEORETICAL MODEL FOR SUNSPOT COOLNESS
R. K. Jaggi Washington, NASA, Oct. 1963 17 p refs
(NASA TN D-1906) OTS: $0.50

A theoretical model is developed for the behavior of sunspots as individuals. Two models, called the current sheath model and the snowplow model, known in the theory of the pinch effect, are worked out for the present problem of the sunspot expansion. Using the observational fact that the magnetic field of the sunspots grows to about 3,000 G in about ten days, numerical calculations based upon the current sheath model show that the sunspot area grows with the magnetic field and begins to pulsate when the magnetic field stops growing. The amplitude and frequency of oscillation depend upon the mass in the current sheath and the maximum magnetic field. The model suggests that the bright ring about the sunspots may exist at chromospheric height where the density of the material is about 10^9 particles/cm^3. Author

N63-23727 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
STELLAR SCINTILLATION AT PULKOVO
A. N. Demidova Dec. 3, 1962 18 p refs Transl. into ENGLISH from Izv. Glavnoy Astron. Observ. (Kiev), v. 21, no. 6, 1960 p 2–11
(FTD-TT-62-1430/1+2)

The results of observations of stellar scintillations on the AZT-7 telescope are stated. A law of the change in amplitude of scintillation is determined with zenith distance. It is indicated that the law varies, depending on the diameter of the inlet opening. A correlation has been found between the amplitude of scintillation, and the quality of the stellar images. Data on the character of amplitude variation of scintillation with various apertures (from 30 mm to 200 mm) are introduced. The wavelength of density fluctuations in the effective turbulent layer of the atmosphere responsible for stellar scintillation is calculated for three nights of observations according to the Rösch theory. Author

N63-23735 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
ONE MORE PORTRAIT OF THE MOON
L. Strizhevskaya May 10, 1963 7 p Transl. into ENGLISH from Izvestiya, Sept. 9, 1962 p 3
(FTD-TT-63-335/1)

An infrared system for taking pictures of the moon is discussed. The photographs are taken in infrared rays in the range 0.9 to 2.3 microns, but not directly on a photographic plate. Instead, an intermediate converter (a television apparatus) for converting the invisible red rays into visible rays is used. The image of the moon, amplified with the aid of a telescope, is directed onto a television pickup which is sensitive to infrared rays. P.V.E.

N63-23805 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THEORY OF ORBIT DETERMINATION – PART II, ESTIMATION FORMULAS
John D. Anderson Oct. 1, 1963 11 p refs
(NASA Contract NAS7-100)
(NASA CR-52270; JPL-TR-32-498) OTS: $1.60 ph, $0.80 mf

A description of the parameter estimation formulas that are currently in use for the orbit determination of space vehicles is presented. The weighted least-squares-estimator with the inclusion of a priori parameter information is defined, and its relation to the maximum-likelihood-estimator is discussed. The Schmidt–Kalman estimator is described and compared with the least-squares-procedure, showing under what conditions the two formulas are mathematically equivalent. Author

N63-23806 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
MARS ATMOSPHERE ENTRY PARAMETRIC STUDY
J. M. Brayshaw Sept. 15, 1963 109 p refs
(NASA Contract NAS7-100)
(NASA CR-52271; JPL-TR-32-458) OTS: $9.10 ph, $3.47 mf

The expected extreme model atmospheres as well as the anticipated extremes of initial entry velocity, entry angle, and ballistic coefficient were included in the study. As functions of these variables, the following parameters are plotted in graphical form: (1) flight path acceleration vs altitude; (2) mach no. vs altitude; (3) dynamic pressure vs altitude; (4) heating rate vs altitude; (5) flight path angle vs altitude; (6) atmospheric velocity vs altitude; (7) altitude vs time; (8) altitude vs planet centered angle. In addition, summary plots of peak heating rate, peak acceleration, unretarded impact velocity, and altitude for parachute deployment are shown as a function of entry angle for the extremes of ballistic coefficient and model atmosphere. Author

N63-23814 Manchester U., Macclesfield (Gt. Brit.)
DEVELOPMENT OF THE LUNAR TOPOGRAPHY INTO SPHERICAL HARMONICS, I. Technical Note No. 1
C. L. Goudas June 1963 30 p refs
(Contract AF 61(052)-524)
(AFCRL-63-744)

Numerical values of the coefficients J_{ij} and J'_{ij} of the expansion of the lunar topography into spherical harmonics are given. Terms up to the 8th order were considered and, therefore, 81 zonal and tesseral harmonics were included in this expansion. The basic data employed in this study are those by Schrutka–Rechtenstamm, and the method of determining J_{ij} and J'_{ij} ($j \leq i = 1, 2, \ldots 8$) is that of the two independent variables least-square fitting. The coefficients obtained in this way provide sufficient basis for the preparation of a contour map of the lunar surface. Author

30 SPACE VEHICLES

Includes: launch vehicle—spacecraft combinations; operating problems; and stability and control.

For manned space capsules, satellites, and space probes see: 32 Space Vehicles (Spacecraft).

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For related information see: 04 Aircraft; 08 Communication; and 22 Navigation and Guidance.

N63-23019 Avco-Everett Research Lab., Everett, Mass.
NONEQUILIBRIUM AND EQUILIBRIUM RADIATION AT SUPER-SATELLITE RE-ENTRY VELOCITIES
R. A. Allen, P. H. Rose, and J. C. Camm Sept. 1962 72 p 50 refs
(NASA Contract NAS9-156; Contract AF 04(694)-33)
(NASA CR-51743; Avco-Everett Res. Rept.-156; BSD-TDR-62-349) OTS: $7.60 ph, $2.36 mf

Vehicles reentering the earth's atmosphere from lunar and interplanetary missions will encounter radiative heating significantly greater than was experienced by ICBM and satellite reentry vehicles. An electric arc-driven shock tube has recently been developed which produces shock waves at supersatellite reentry velocities. Photometric measurements of the radiation behind normal air shock waves have been made in this high-performance shock tube, and the engineering estimates of the radiation heating derived from these measurements are described in this paper. Measurements were made of the nonequilibrium and equilibrium radiation from normal air shocks at initial pressures varying from 1.0 to 0.05 mm Hg, (simulated altitudes 110,000 to 255,000 ft) and at shock velocities from 16,500 to 36,200 fps. From time histories of the resolved shock front radiation at various wavelengths and at various velocities and pressures, a parametric description of the radiation was obtained. Quantitative equilibrium and integrated nonequilibrium radiation intensities, the width of the nonequilibrium region, and the time required by the radiation to peak behind the shock front have been measured. Author

N63-23027 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ABORT FROM A COPLANAR CIRCUMLUNAR ORBIT
N. J. Braud June 29, 1962 20 p 1 ref
(NASA TM X-50805; MTP-AERO-62-55) OTS: $1.60 ph, $0.80 mf

The abort from a typical coplanar, circumlunar orbit is considered, where the abort is implemented by an impulsive kick, and where all abort trajectories are selected to achieve a certain reentry corridor. The investigation is conducted on the Jacobian model of the restricted three-body problem. The results provide the time to reentry, reentry velocity, and maximum distance from the earth that is reached after the abort. Author

N63-23190 Borg-Warner Corp., Kalamazoo, Mich. Ingersoll Kalamazoo Div.
ADHESIVE BONDINGS OF END CLOSURES FOR HIGH STRENGTH AND RELIABILITY IN ROCKET MOTOR CASES Final Report
D. P. Thomason July 15, 1963 60 p
(Contract NORd-15719)
(SPDIR-28)

Preliminary studies of the bonded-joint fabrication technique were conducted with 26 uniaxial-lap and scarf-joint specimens and 17 subscale test cases of 5-in. nominal

diameter and 18-in.-length. Fifteen of the subscale units exceeded the target bonded-joint strength of 3750 psi by an average of 40%. The information gained from these preliminary tests was applied to the fabrication of 16 prototype bonded end closure cases of 16 in.-nominal diameter and 41 in.-length. Results of limited work with MBMC #1 and Super Tricent steel welded and seamless cases are included as followup and conclusion to the 1960 and 1961 studies, in which controlled surface decarburization was used to reduce the notch sensitivity of these high-carbon steels. Author

N63-23191 Aerojet-General Corp., Sacramento, Calif. Solid Rocket Plant

RESEARCH AND DEVELOPMENT IN SUPPORT OF THE POLARIS PROGRAM. TASK II: HYDROSTATIC TEST PROCEDURES [Second Bimonthly Progress Report], July 1-Aug. 31, 1963

F. J. Climent Sept. 30, 1963 21 p 1 ref

(Contract NOw 63-0627c (FBM))

This report describes an investigation conducted to determine the effect of various hydrostatic-test parameters on the structural integrity of filament-wound chambers. Some preliminary testing carried out to check instrumentation and procedures are included. Author

N63-23210 Hughes Aircraft Co., Culver City, Calif.

LAUNCH VEHICLE COST ANALYSIS AND SYSTEM EVALUATION

Stanley Hauer, George Tabata, and Robert Waters (Space Technol. Labs.) *In* AIAA 2nd Manned Space Flight Meeting [1963] p 51-56 (See N63-23201 24-01)

The purpose of these studies was to develop a methodology and data for performing cost analyses and system evaluation for different launch-vehicle designs in the Saturn and Nova classes. This paper presents, in summary form, a technique for developing cost category models. Design values for the C-1 launch vehicle were used, and estimated costs for this system are listed. Author

N63-23213 General Electric Co., Valley Forge, Pa.

EXTRAVEHICULAR MAINTENANCE AND TECHNIQUES

Carl R. Cording *In* AIAA 2nd Manned Space Flight Meeting [1963] p 86-91 (See N63-23201 24-01)

Three basic parameters influencing the ability of man to perform extravehicular maintenance were investigated. These were: his ability to apply maximum short-duration push/pull and torque forces; his ability to apply these forces, push/pull and torque, as a relatively constant force application; and the time to accomplish a given hypothetical series of complex tasks. Results indicate that: (1) Man's ability to apply push force ranges between 40 and 55% of his terrestrial capability. (2) Man's ability to apply pull force ranges between 50 and 65% of his terrestrial ability. (3) Man was able to perform a relatively complex maintenance task simply by using his off hand for restraint. (4) Man was approximately 50% as efficient in five degrees of freedom as on earth, on a time basis. (5) A great deal of adaptation and learning occurs in a relatively short time in this frictionless environment. I.v.L.

N63-23216 Ritchie and Associates, Inc., Dayton, Ohio

CONTROL-DISPLAY DESIGN IN MANNED SPACE SYSTEM DEVELOPMENT

Edward L. Warren and Malcolm L. Ritchie *In* AIAA 2nd Manned Space Flight Meeting [1963] p 111-113 (See N63-23201 24-01)

The organization of information and getting it to the operator so that he can understand clearly what the situation is and what controls he may use to effect his decision is the basic problem of the design of a control-display system. Investigations of this problem have led to the following tentative conclusions: (1) The role of man in vehicle control is determined, deliberately or not, by the early crystallization of the system design. Required overall system performance can only be assured if that role is based on sound detailed prediction of man's performance in the specific system design. (2) There is no substitute for a sound experimental program in control-display. Newly required equipment must be anticipated and developed by the time it is needed in a specific system. I.v.L.

N63-23224 Boeing Co., Seattle, Wash.

ENGINEERING MANAGEMENT TO ACHIEVE RELIABILITY IN MANNED SPACE SYSTEMS

Leslie W. Ball *In* AIAA 2nd Manned Space Flight Meeting [1963] p 181-186 (See N63-23201 24-01)

The achievement of reliability in manned spaceflight requires strict engineering discipline. An engineering management system is described. This system provides for development and application of formal discipline, wherever experience has shown that it is needed to help solve the space reliability problem. In communicating an understanding of this system, it is necessary: (1) to present a matrix of the activity groups that are critical to reliability; (2) to relate each activity group to the probability of failure; and (3) to discuss program management, contracting, and purchasing in relation to obtaining the required level of discipline. Author

N63-23229 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A MANUAL ABORT TECHNIQUE FOR THE MIDCOURSE REGION OF A LUNAR MISSION

George P. Callas and Robert B. Merrick *In* AIAA 2nd Manned Space Flight Meeting [1963] p 217-223 refs (See N63-23201 24-01)

A manual abort system consisting of precomputed charts and an inertial measurement system is described. The system was evaluated by simulation on a digital computer. The results of this evaluation show that the use of precalculated charts to aid in the computation of the abort velocity is feasible. The incorporation of the abort way stations makes possible the location of desired landing sites on the charts. The error in estimating the state vector at the abort way stations is dependent on the observation schedule employed; thus, the location of the way stations should be considered in choosing the observation schedule. I.v.L.

N63-23231 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SPACE AGE TRANSPORTATION SYSTEMS

L. T. Spears and C. H. Rutland *In* AIAA 2nd Manned Space Flight Meeting [1963] p 229-235 (See N63-23201 24-01)

Space transportation systems of different types are being investigated for support of manned operations in earth orbit and on lunar surface at the levels expected in the 1970's and beyond. Among the alternatives, the concept of reusable space vehicles, operating as ferry or shuttle transports, seems to approach most nearly the characteristics of successful earth surface transportation systems. Application of this concept, particularly for passenger transportation between earth surface and orbit, between earth orbit and lunar orbit and for operation between the lunar surface and lunar orbit is discussed. It seems likely, at this time, that an airplane-type, reusable ferry vehicle will be developed in the foreseeable future for transport of passengers between earth and orbit. Also, the applicatio

of the concept to lunar transportation, in the form of reusable nuclear ferry vehicles and lunar shuttle vehicles, appears as one of the promising alternatives. I.v.L.

N63-23233 Princeton U., N.J.
MAN'S UTILITY IN MILITARY SPACE MISSIONS
Courtland D. Perkins *In* AIAA 2nd Manned Space Flight Meeting [1963] p 254–259 (See N63-23201 24-01)

The following points are made concerning man's utility in military space missions: (1) the advance of the total national space program has been amazing, and, as a result, a rather firm grasp on many aspects of space technology has been achieved; (2) although many possible military missions in space have been identified by many studies, only reconnaissance/surveillance has achieved any real recognition and is being developed seriously; (3) the so-called "space gap" has been closed in most areas of space activity except in the field of manned space developments; (4) rationale for man in military space is usually based on doctrinal or other inadequate arguments; (5) the building block programs of Titan III, Blue Gemini, and X-20 are extremely important and bear on the development of man's ultimate pay-off in space weapon systems; (6) the great cost of placing payloads into orbit is such that it limits most of today's important manned military space possibilities; and (7) the military space program is floundering badly and needs a firm goal to focus its research and development objectives. P.V.E.

N63-23241 Boeing Co., Seattle, Wash.
FUTURE SPACECRAFT DESIGN REQUIREMENTS AND TRENDS – MANNED SYSTEMS
E.Z. Gray *In* AIAA 2nd Manned Space Flight Meeting [1963] p 351–359 (See N63-23201 24-01)

The characteristics of future manned spacecraft are discussed; it is expected that manned spacecraft of the future will emphasize operation at high-orbit altitudes. They will require use of space propulsion for rendezvous, space maneuvers, and return. The propulsion units will be separable and disposable for high-altitude operation, even when recoverable first stages are used. Reentry spacecraft will require use of lift to provide sufficient corridor width for superorbital reentry. For operational systems, the L/D range over 1.0 appears the most attractive, considering all the variables affecting reentry accuracy. Variable geometry plus rocket augmentation will be used to provide landing-site acquisition and all-weather landings. Composite structure appears most attractive for reentry vehicles. P.V.E.

N63-23307 Air Force Cambridge Research Labs., Bedford, Mass.
PROJECT SCORPIO: A PROPOSED SATELLITE SYSTEM FOR IMPROVING ATLANTIC MISSILE RANGE ACCURACY AND CALIBRATING OPERATIONAL MISSILE RANGING SYSTEMS Technical Proposal
Armando Mancini, Harry R. Kahler (Wolf Res. and Develop. Corp.), and Caleb Warner (Edgerton, Germeshausen and Grier, Inc.) *In its* Compendium of Papers in the Fields of Geodesy and Planetary Geometry Aug. 1963 52 p (See N63-23301 24-01)

Project SCORPIO is a satellite system primarily designed to calibrate range instrumentation equipment for missile ranges. As a result of high quality tracking data collected to satisfy this mission, the program also will provide valuable geophysical data usable for research to support missile and satellite operations. In addition, it will refine the geocentric coordinates of several worldwide tracking stations critically needed for military space programs. The satellite will carry a MISTRAM, a GLOTRAC and a DPN-66 transponder, along with an optical beacon which can be photographed against a stellar background. The satellite package will weigh approximately 300 pounds and will be placed into a low eccentricity orbit, about 500 miles above the earth. The inclination of the orbital plane, dictated by the location of the electronic tracking stations, is to be on the order of 40 degrees. Author

N63-23362 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DYNAMIC RESPONSE OF RISING AND FALLING BALLOON WIND SENSORS WITH APPLICATION TO ESTIMATES OF WIND LOADS ON LAUNCH VEHICLES
Wilmer H. Reed, III Washington, NASA, Oct. 1963 33 p refs (NASA TN D-1821) OTS: $1.00

An analytical evaluation is made of the capabilities of balloon wind sensors to respond to detailed variations in the wind structure of the atmosphere, which can represent important load inputs for flexible launch vehicles. Both rising and falling spherical balloons are considered. It is found that for a balloon of given weight there is an optimum diameter for which the balloon response velocity is most sensitive to variations in the profile of horizontal winds. When the diameter of the balloon is larger than this optimum value, the advantages of reducing the balloon weight to improve its dynamic response become relatively insignificant. The apparent mass of ambient air surrounding the balloon is found to be of considerable importance at lower altitudes, where launch vehicles often encounter maximum aerodynamic loads. Author

N63-23554 Aerospace Corp., El Segundo, Calif.
PLANE CHANGE WINDOW CONSIDERATIONS
B. H. Billik July 9, 1963 19 p 4 refs
(Contract AF 04(695)-269)
(TDR-269(4130-10)-5; SSD-TDR-63-200)

Plane change windows constrained by both velocity and azimuth limits are presented for a series of target orbit inclinations and two typical launch sites. In addition, tables showing the degradation of the window due to the azimuth constraint alone are included. Author

N63-23652 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLIGHT TEST AND ANALYSIS OF THE ROLLING MOTIONS OF A 79° CLIPPED DELTA CONFIGURATION WITH WING-TIP FINS AT SUPERSONIC SPEEDS
James L. Raper Washington, NASA, Nov. 1963 56 p refs (NASA TN D-2017) OTS: $1.50

A free-flight investigation was conducted to determine the aerodynamic characteristics and motions of a rocket-boosted model of a simplified hypersonic glider configuration with wing-tip fins and a blunt base through a Mach number range extending up to 4.4. The model was statically and dynamically stable at small angles-of-attack, and experienced coupled motions when pitched to an angle-of-attack of about 12°. The addition of the wing-tip fins resulted in no improvement of the vehicle motions compared with the same vehicle with no fins. In general, the coupled motions experienced by the model were simulated by the use of the equations of motion for five degrees of freedom. Author

N63-23675 Joint Publications Research Service, Washington, D.C.
FOUR-DAY SPACE FLIGHT OF THE VOSTOK-3
A. Nikolayev Oct. 28, 1963 7 p Transl. into ENGLISH from Kryl'ya Rodiny (USSR), no. 5, May 1963 p 3–5
(JPRS-21146(Rev.); OTS-63-31791) OTS: $0.50

The astronaut's account of the Vostok III flight is presented including a discussion of the physical exercise and

sports activities involved in preflight training. The first orbit, lasting 88 1/2 minutes, was used for a general surveying of the situation and a finding out of how the organism behaves in flight. Nothing unexpected happened during the flight, and the astronaut experienced no unpleasant sensations. On the fourth orbit, the astronaut experimented with "free flight" inside the spaceship and described it as a unique sensation. However, the astronaut feels that the lack of any need to exert physical effort can result in a lowering of the proper muscle tone and thus have adverse effects during the return to earth. J.E.T.

N63-23729 Air Force Systems Command Wright-Patterson AFB, Ohio Foreign Tech. Div.
ROCKET TESTING
Ion Trofin Dec. 13, 1962 8 p Transl. into ENGLISH from Stiinta si Tehnica (Rumania) no. 9, Sept. 1961 p 18–19
(FTD-TT-62-1478/1+2+3+4)

An account of the typical prelaunch testing procedures for the Vostok spacecraft is presented. Included are descriptions of aerodynamic tests, the test stand itself, and flight testing of the rocket. J.E.T.

N63-23731 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
ROCKETS AND STRATEGY
V. Larionov Nov. 14, 1962 10 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), Mar. 18, 1962 p 4
(FTD-TT-62-1580/1+2+4)

A new intercontinental rocket, called the global rocket, is discussed. This weapon is invulnerable to antimissile defense. The new global rockets can fly around the globe in any direction and deal a blow to any given target. These rockets can fly to the U.S.A. in a completely different direction from that covered by the warning systems. Using the global rocket, the U.S.S.R. can bomb the U.S.A. from the "back entry" by firing the rockets over the Pacific Ocean or even over the South Pole and South America. Also discussed are American plans for military exploitation of outer space. I.v.L.

N63-23754 National Aeronautics and Space Administration, Washington, D.C.
NASA TO TEST APOLLO SPACECRAFT ESCAPE SYSTEM News Release No. 63-247
Nov. 5, 1963 9 p
Available from NASA, Office of Scientific and Technical Information, Wash., D.C.

The National Aeronautics and Space Administration has announced that it will conduct the first off-the-pad abort test involving the Apollo spacecraft launch-escape system, no earlier than Nov. 7, at the White Sands Missile Range, New Mexico. NASA's Manned Spacecraft Center, Houston, is conducting the test. An engineering test vehicle that duplicates the size and weight of the three-man command module of the Apollo spacecraft will be used. It will lift off a concrete pad powered by the Apollo launch-escape motor mounted on a launch-escape tower attached to the module. The purpose of the test is to determine the stability and operational characteristics of the escape configuration during a pad abort. This is the first rocket-powered test of this particular spacecraft-tower configuration. P.V.E.

N63-23782 National Bureau of Standards, Washington, D.C.
FEASIBILITY OF MEASURING OR COMPENSATING DRAG ON A MANNED SATELLITE News Release
Sept. 1963 3 p refs

The methods considered involve external jets, a torsion system, and a drifting test object enclosed in a housing, all to be operated or observed by the astronaut. Information obtained from a satellite so equipped would be immediately helpful in determining atmospheric densities and the figure of the earth, and would eventually be useful in providing experience in the design and operation of a zero-g space laboratory. Author

N63-23795 National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
SEALING MANNED SPACECRAFT
Otto F. Trout, Jr. N.Y. Am. Inst. of Aeron. and Astronautics, Repr. from Aeron. and Aerospace Eng., Aug. 1963 3 p refs (NASA RP-39)

A study of sealing problems in extended space missions has shown that acceptable leakage rates for atmospheric confinement are possible with the presently available seal materials providing: that the seal materials and flanges are free of defects; that the seating stress is maintained above the minimum acceptable value for vacuum use along the entire length of the seal during all dynamic and static conditions; and that the seals are protected against ultraviolet and electromagnetic radiation, high temperature, and micrometeoroid damage. Accelerated research is needed in the field of elastomeric polymers to define the properties of available materials and to develop materials having a greater high-temperature resistance, better aging and chemical resistance, and more resistance to permanent set in hard vacuum for extended periods of time. Also, it is of utmost importance that the engineer integrate seal design with all phases of spacecraft design. I.v.L.

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes: boosters; clustered rockets; and multistage rockets.

For propulsion engines see: 27 Propulsion.

For launch vehicle - spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N63-23123 National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
FLIGHT VIBRATION DATA FROM THE DELTA 9 LAUNCH VEHICLE
Lloyd A. Williams Washington, NASA, Oct. 1963 24 p 2 refs (NASA TN D-1683) OTS: $0.75

Vibration data for the three principle axes of the payload support structure were obtained from liftoff through third-stage motor burnout. Maximum vibration levels during first- and second-stage burning occurred at liftoff, staging, and fairing jettison with low levels between events. The maximum composite vibration levels for first- and second-stage burning were 2.5 g peak and 1.9 g peak for the thrust and lateral axes, respectively, and occurred at liftoff. The third-stage motor exhibited the normal resonant burning characteristics for this type of motor, that is, the tangential and longitudinal modes caused by acoustical cavity resonances. However, since this phenomenon is already well documented, the primary purpose of this vibration experiment was to record low-frequency high-stress amplitude vibration. Consequently, the measuring systems were set up to measure low-level first- and second-stage modal vibrations. Author

32 SPACE VEHICLES (SPACECRAFT)

Includes: manned space capsules; satellites; and space probes.

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For Launch vehicle—spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N63-23013 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOL. 3, NO. 19
Sept. 30, 1963 20 p
(NASA TM X-50910; NASA X-533-63-1) OTS: $1.60 ph, $0.80 mf

The following information is presented for U.S. and U.S.S.R. objects in orbit: object, code name, source, launch, nodal period, inclination, apogee, perigee, and transmitting frequency. Information is given on decayed objects from 1957–1963. R.T.K.

N63-23016 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOL. 3, NO. 17
Aug. 31, 1963 9 p
(NASA TM X-50613; NASA X-533-63-1) OTS: $1.10 ph, $0.80 mf

The following information on objects in orbit is presented: code name, source (U.S. or U.S.S.R.), launch date, nodal period, inclination, apogee, perigee, and transmitting frequency. Objects that have decayed since Aug. 17, 1963, are also listed. P.V.E.

N63-23023 Environmental Research Associates, Randallstown, Md.
SPACE STATION CONNECTION AND SEAL STUDY
Harry L. Loats, Jr., et al Oct. 1962 149 p 59 refs
(NASA Contract NAS1-2164)
(NASA CR-51303) OTS: $11.00 ph, $4.67 mf

Studies, evaluations, and recommendations for reliable, easily replaceable seals and connection components, proposed for use in self-erecting, manned space stations, are discussed. Connection and seal configurations considered were of the following major types: (1) docking and initial access, (2) intersection bulkhead doors, (3) section hinge joints, (4) intermodule locks, (5) sliding spoke joints, (6) rotating spoke joints, and (7) electrical and fluid transfer connections and seals. From an investigation of the relationships between seal material, diameter, deflection, permeability, and interface leakage, and from generalized numerical results for determining flange loadings and overall leak rates, several base point connection and seal configurations were analyzed to yield (1) operating criteria, (2) stress values of the seal, (3) stress values of the connection, and (4) connection locking requirements. P.V.E.

N63-23029 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EARTH-VENUS TRAJECTORIES, 1965-66
V. C. Clarke, Jr., R. Y. Roth, W. E. Bollman, T. W. Hamilton, and C. G. Pfeiffer May 15, 1963 790 p 9 refs
(NASA Contract NAS7-100)
(NASA CR-51681; JPL-TM-33-99, Vol. 2, Pt. B) OTS: $31.00 ph, $23.90 mf

Earth–Venus trajectory characteristics are given for flight times from October 20 to November 28, 1965. Tabular data include heliocentric conic computations, planetocentric conic computations, differential corrections, midcourse guidance data, and orbit determinations. J.E.T.

N63-23157 International Geophysical Year World Data Center A, Washington, D.C.
ROCKETS AND SATELLITES: ELEVENTH 6-MONTHLY CATALOGUE OF DATA, July 1-Dec. 31, 1962
Washington, Natl. Acad. Sci., [1963] p 90–106 refs

Tabulations of data on sounding rockets (Australia, 1958–1962 and Soviet Union, 1959–1961), artificial satellites (July–December 1962), and space probes (July–December 1962) are presented. Data presented include: date and time of launch and reason for satellite or probe (temperature, pressure, wind measurements, etc.). P.V.E.

N63-23202 National Aeronautics and Space Administration, Washington, D.C.
SYSTEMS ENGINEERING FOR MANNED SPACE FLIGHT
Joseph F. Shea *In* AIAA 2nd Manned Space Flight Meeting [1963] p 4-8 (See N63-23201 24-01)

The overall nature of the work of systems engineering can be illustrated by the mission mode decision and the planning of the possible future manned space flight programs, such as the Lunar Logistic System, the Space Station, and the Planetary Programs. Concentration is placed on the requirements for such systems and on the study programs which must be conducted to answer the eternal questions: what, when, and how. These studies are usually implemented by the centers and contractors working either for the centers or for OMSF. Then the study results are pulled together, the system concept is selected, and the system specification and the program plan are developed. The object is to have available, at the start of any future program, the blueprint from which the development team can proceed. I.v.L.

N63-23203 Strategic Air Command, Offutt AFB, Nebraska
MILITARY ASPECTS OF MANNED SPACE FLIGHT
Thomas S. Power *In* AIAA 2nd Manned Space Flight Meeting [1963] p 9–12 (See N63-23201 24-01)

Three potential approaches to strictly military space applications are discussed. One such approach concerns future means for command and control of global strike forces. It may well eventually become evident that the only really survivable command structure—not only for SAC but for all military forces—would be a maneuverable command post in space. The second approach concerns space-based manned systems capable of destroying enemy missiles during their boost phase or in midcourse. A third approach concerns the inspection of potentially hostile satellites by means of maneuverable spacecraft, manned by crews who can search out suspected weapons carriers, board them, and, if required, neutralize them. In order to counter the overall military threat from space, that combination of the three approaches must be selected which makes the most economic use of human and material resources on one hand, and, on the other, assures an adequate military space capability for both the immediate and distant future. I.v.L.

N63-23204 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FLIGHT EXPERIENCES IN THE MERCURY PROGRAM
M. Scott Carpenter and Virgil I. Grissom *In* AIAA 2nd Manned Space Flight Meeting [1963] p 13–16 (See N63-23201 24-01)

Flight experiences in the Mercury program are reviewed. Alan Shepard's flight confirmed the adequacy of all elements of the system, including the computers, booster, spacecraft, men, and procedures. The attitude-control system worked well and verified the accuracy of simulations, ignition of the retrorockets proved to be smooth, and attitude excursions produced by retrofire appeared to be easily controlled by the pilot. The flight of Gus Grissom proceeded normally in all respects until shortly after impact; then the explosive side hatch, which was flown for the first time, detonated prematurely for reasons still undetermined. John Glenn confirmed that there was no undesirable vestibular effects, no nausea, no vision problem, and, subjectively, no reduction in ability to withstand acceleration after long periods of weightlessness. Walter Schirra made extensive use of drifting flight in which no attitude control is attempted, thereby conserving fuel consumption. I.v.L.

N63-23205 National Aeronautics and Space Administration, Washington, D.C.
RESEARCH REQUIREMENTS FOR FUTURE MANNED SPACE FLIGHT COMMUNICATIONS
John M. Walker *In* AIAA 2nd Manned Space Flight Meeting [1963] p 17–22 (See N63-23201 24-01)

The nominal communications requirements for future manned spaceflight are: bit rate = 10^6 sec; size and weight = no increase; reliability = order of magnitude of improvement; and primary power = no increase. Methods for improving the performance of communication systems, which are discussed, are as follows: (1) increasing antenna sizes; (2) increasing transmitter power; (3) increasing the frequency; and (4) lowering the system noise temperature. Other methods under discussion are improving the modulation techniques to closer approximate Shannon's limit, employing on-board data processing to eliminate redundancy and thereby increasing the information per bit, and careful design of the experiments to be conducted during space missions. Also, approaches to the minimization of the blackout period created during reentry by the shock-induced plasma surrounding the spacecraft are discussed. I.v.L.

N63-23206 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
GEMINI PROGRAM AND MISSION
James A. Chamberlin and James T. Rose *In* AIAA 2nd Manned Space Flight Meeting [1963] p 23–32 refs (See N63-23201 24-01)

The Gemini program was established to provide a flexible space-vehicle system which can be used to explore the many problems of manned operation in a space environment in much greater detail and depth than could be accomplished with the pioneering Mercury vehicles. Flights up to 14 days in duration will be attempted, and techniques for rendezvous and docking with another space vehicle will be established. Some details of these and other associated mission objectives are discussed. I.v.L.

N63-23207 Air Force Systems Command, Los Angeles, Calif. Space Systems Div.
THE TITAN III STANDARDIZED SPACE LAUNCH SYSTEM
Joseph S. Bleymaier *In* AIAA 2nd Manned Space Flight Meeting [1963] p 33–38 (See N63-23201 24-01)

Titan III is the popular name for Program 624A Standard Space Launch System now under development. Standardization—one of the keynotes to the Titan III philosophy—will give it greater mission flexibility than any other launch vehicle or system now under development. Payload capability will range from 5000 to 25,000 pounds, and mission capability will include: low altitude elliptical orbit by direct injection; low altitude circular orbit; low altitude circular orbit with Hohmann transfer to another orbit; synchronous orbit; and deep space trajectory to escape. The integrate-transfer-launch will give Titan III quick responsiveness, a quality required of any military system. Minimum pad time is ensured through off-pad assembly, payload integration, and checkout leading to high launch rates from fewer pads with resulting economy. I.v.L.

N63-23208 National Aeronautics and Space Administration, Washington, D.C.
FUTURE OF LARGE LAUNCH VEHICLES
John W. Stone *In* AIAA 2nd Manned Space Flight Meeting [1963] p 39–43 (See N63-23201 24-01)

Results, to date, of the study of large launch vehicles such as the NOVA, RENOVA, and ROMBUS, lead to the following conclusions concerning the future vehicles which will follow or supersede SATURN V: (1) A new large launch vehicle in the 500-ton orbital payload class will be justified only if one or more of the following mission requirements materializes: (a) manned planetary exploration; (b) large lunar base; (c) large orbital or global cargo missions. (2) Takeoff weights of a 500-ton orbital payload class vehicle range from 15 to 40 pounds. Two-stage expendable liquid vehicles are the lightest, and solid first-stage vehicles are the heaviest. (3) Development time for a vehicle in this class will range from seven to nine years, and the developmental costs would be from 3.5 to 6 billion dollars. (4) Reusability is most desirable and will result in transportation efficiencies. (5) The vehicle concepts considered must be compatible with the requirements for low-density payloads of 2 to 3 lbs/ft^3 and diameters of not less than 60 ft. I.v.L.

N63-23209 Chance Vought Corp., Dallas, Tex.
MANUAL CONTROL OF LAUNCH VEHICLE SYSTEMS
W. B. Luton *In* AIAA 2nd Manned Space Flight Meeting [1963] p 44–50 refs (See N63-23201 24-01)

Two simulator studies concerning manual control of launch vehicle systems are discussed. The first study is a simulation of a two-stage launch vehicle and a manned lifting ballistic capsule. The results of this study indicate that the human operator, when given adequate display information, can control the trajectory of a launch vehicle with the required precision. Also, a variety of abort situations encountered in this study demonstrated how a pilot's judgment and flexibility can be utilized to: (1) adjust trajectory errors; (2) abort the primary mission and select and carry out an alternative mission; and (3) delay thrust termination and alter the trajectory to make the safest capsule escape and/or reach an optimum recovery area. The second study was concerned with the simulation of a lunar landing craft. Results indicate that the pilot is capable of controlling the launch, transfer, and terminal phases of the lunar landing mission. Display requirements were considerably less complex than is usually expected. I.v.L.

N63-23214 North American Aviation, Inc., Columbus, Ohio
A VISUAL PRESENTATION SIMULATOR USED FOR INVESTIGATIONS OF VARIOUS PHASES OF LUNAR FLIGHT
J. E. Willer *In* AIAA 2nd Manned Space Flight Meeting [1963] p 92–98 refs (See N63-23201 24-01)

This paper describes a Visual Presentation Simulator used for man-in-the-loop simulation investigations of various phases of the lunar landing mission. This simulator consists of a full-scale fixed-base cockpit mockup with operating instruments, a closed-circuit television system, a terrain model, a servo-powered six-degree-of-freedom TV camera transport, and an analog computer. Specific techniques and equipment used to enhance the realism and to adapt the simulator to various phases of the mission are discussed. Author

N63-23227 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MISSION CONTROL FOR MANNED SPACE FLIGHT
Christopher C. Kraft, Jr., John D. Hodge, and Eugene F. Kranz *In* AIAA 2nd Manned Space Flight Meeting [1963] p 199–205 (See N63-23201 24-01)

This paper traces the development of the real-time controlling agency from its concept through a Mercury mission to Project Apollo. In the course of this paper the flight-control tasks are identified and developed commensurate with the time frame allowed. Author

N63-23228 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
GEMINI LAUNCH ESCAPE
Warren J. North and William B. Cassidy (Ling-Temco-Vought) *In* AIAA 2nd Manned Space Flight Meeting [1963] p 213–216 (See N63-23201 24-01)

The Gemini launch modes, ejection seats, retrorockets, and maneuver rockets have been tailored to the design and dynamic characteristics of the launch vehicle and spacecraft. A flight crew is included in the abort decision loop. A launch simulation was conducted to evaluate the launch-vehicle displays and to confirm that the crew could assess the status of the launch vehicle and take abort action if necessary. Results indicate that the incorporation of a redundant guidance and control system and a flexible launch-vehicle monitoring system has greatly enhanced the Gemini reliability and crew safety. I.v.L.

N63-23230 National Aeronautics and Space Council, Washington, D.C.
SPACE STATIONS AND THE NATIONAL SPACE PROGRAM – A CHALLENGE
Thomas E. Dolan *In* AIAA 2nd Manned Space Flight Meeting [1963] p 224–228 (See N63-23201 24-01)

Challenges of space-station activities and the national space programs are discussed. These challenges include: (1) the discipline to go through the often agonizing process of developing a fundamental picture of national space activities; (2) the utilization of this picture when passing judgment on proposed new missions, hardware programs, or lines of endeavor; (3) the recognition of the national character of the space program and the common civil and defense test needs in the early phases of a space-station activity; (4) the penetration of the subject of space-station applications deeper than heretofore; (5) the definition of a program which: (a) makes maximum utilization of present hardware systems, (b) reflects long-range evolution rather than short-term expediency, (c) is sufficiently flexible to absorb major decisions and back up existing programs, and (d) is consistent with some reasonable demands on resources. Also discussed are management, decision making, and support as applied to the proposed space station. I.v.L.

N63-23232 Lockheed Missiles and Space Co., Sunnyvale, Calif.
MANNED FLIGHT TO MARS AND VENUS IN THE 70'S
Benjamin P. Martin *In* AIAA 2nd Manned Space Flight Meet- [1963] p 236–253 refs (See N63-23201 24-01)
(NASA Contract NAS8-5024)

Velocity requirements associated with various flight paths to Mars and Venus and the resulting propulsion and reentry weights are combined and varied with other missions system weights which are a function of mission goals, trip time and environmental protection. From these weight tradeoff analyses are evolved spacecraft design concepts and total mass requirements on earth orbit to accomplish the various missions. System requirements covered in the analyses to determine total mass requirements on earth orbit are: (1) propulsion systems for earth orbit departure; (2) earth entry systems for different missions; (3) life support systems; (4) navigation and control systems; (5) reconnaissance and scientific instrumentation for gathering data during course of missions, and requirements for storage and/or readout; (6) space power supply systems; and (7) vehicle design concepts. Author

N63-23359 National Aeronautics and Space Administration, Washington, D.C.
EXPLORER XVI STOPS TRANSMITTING DATA. RESULTS TERMED SIGNIFICANT News Release No. 63-203
Sept. 15, 1963 5 p
Available from NASA. Office of Scientific and Technical Information, Wash., D.C.

The Explorer XVI meteoroid satellite has ceased transmitting usable experimental data after seven and one-half months of satisfactory performance. During this period, Explorer XVI reported the following results (one mil equals one one-thousandth of an inch): forty-four penetrations of one-mil beryllium-copper; eleven penetrations of two-mil beryllium-copper; six penetrations of one-mil stainless steel; one penetration of three-mil copper; no penetrations of five-mil beryllium-copper or six-mil stainless steel; and the penetration of one cadmium sulfide cell in such a way that it became saturated with sunlight and was no longer useful. Also, there were more than 15,000 meteoroid hits recorded by microphone impact sensors which covered about one-tenth of the total exposed experiment surface. These sensors did not measure penetration. I.v.L.

N63-23413 Applied Physics Lab., Silver Spring, Md.
SCIENTIFIC SATELLITES – A PERSPECTIVE Keynote Address
B. Alexander Kossiakoff *In* Amer. Astron. Soc. Scientific Satellites 1963 p 1–17 (See N63-23412 24-01)

Engineering problems in scientific satellites, and some of the principles and techniques which are available to solve these problems are presented. The following areas of satellite design are discussed: (1) electronic equipment, (2) power systems, and (3) attitude control. R.T.K.

N63-23414 National Aeronautics and Space Administration, Washington, D.C.
S-6, AN AERONOMY SATELLITE
R. Horowitz *In* Amer. Astron. Soc. Scientific Satellites 1963 p 19–39 (See N63-23412 24-01)

This paper reviews the mission and design considerations of S-6, a scientific earth satellite instrumented to obtain data of the physical and chemical processes occurring in the upper atmosphere between 250 and 900 km. After a description of the primary and secondary objectives of the flight, the paper contains a discussion of the neutral mass spectrometers, vacuum gages, and electrostatic probes, which together comprise: the primary detectors; the spacecraft ancillary flight equipment, including the primary power supply, attitude-measuring equipment, telemetry, ground support, and command system; and the environment test conditions. Author

N63-23452 Pennsylvania U., Philadelphia
MANNED EXPLORATION OF SPACE
Christian J. Lambertsen *In* USIA Voice of Amer. Forum Ser. on Space Sci., Jan. 8–May 21, 1962 p 270–282 (See N63-23436 24-01)
(Lecture 18)

The pros and cons of including man in the system for exploring space are appraised. The difficulties associated with manned spaceflight are discussed, including the control of

vibration and acceleration to within tolerable limits, the design of life-support systems to meet man's respirational, thermal, and nutritional requirements, and the provision of protection from the radiation and vacuum of space. Potential debilitating musculoskeletal, circulatory, and vestibular effects of prolonged weightlessness and inactivity are sketched. Also, the added weight of the elaborate apparatus to recreate earth conditions in space must be considered. On the other hand, the use of man as an in-flight participant of space exploration provides an unsurpassed judgment capability in the face of the unforeseen, complemented by the desire to explore and succeed. The success of manned-orbital spaceflights demonstrates that man should be intentionally utilized as a distinct asset except where apparatus alone is capable of the required measurement, where distances or durations are beyond the state of manned spacecraft development, or where the risk to life becomes unacceptable. M.P.G.

N63-23523 Library of Congress, Washington, D.C. Aerospace Information Div.
SOVIET MANNED SPACE FLIGHT. LIFE SUPPORT SYSTEMS: MEDICAL AND BIOLOGICAL ASPECTS OF THE VOSTOK-3 AND VOSTOK-4 FLIGHTS
Nov. 1962 28 p refs Review of Soviet open-literature sources (chiefly newspapers) publ. Aug.–Oct. 1962
(AID Rept. 62-191) OTS: $2.60 ph, $1.04 mf

The Soviet manned spaceflights of the Vostok-3 and the Vostok-4 are reviewed, and detailed discussion is given concerning the life-support systems of the two spacecrafts. The discussion is centered around the preparation of the flights, which included cabin equipment and selection of orbits along with the physical, physiological, and psychological training of the cosmonauts; the medical and biological aspects of the flights, which include medical monitoring, the effects of overloading, of weightlessness, of radiation, of isolation, and of diet. Finally, cabin ecology and the problems of interplanetary flight are reviewed. C.L.W.

N63-23583 Naval Space Surveillance System, Dahlgren, Va.
SATELLITE SITUATION SUMMARY REPORT, 15 OCTOBER 1963
E. F. van Lier Ribbink [1963] 16 p

A list is given of the satellites now in orbit and of the satellites which were orbited and have decayed. C.L.W.

N63-23655 Smithsonian Astrophysical Observatory, Cambridge, Mass.
ATTITUDE DETERMINATION FROM SPECULAR AND DIFFUSE REFLECTION BY CYLINDRICAL ARTIFICIAL SATELLITES
R. H. Giese July 8, 1963 45 p 5 refs
(NASA Grant NsG-87-60)
(NASA CR-52254; SAO Special Rept. 127; Mitt. Astron. Inst. Univ. Tübingen 66) OTS: $4.60 ph, $1.55 mf

Formulae for attitude determination from optical observations are presented for cylindrical artificial satellites with specular reflection. The results allow attitude determination from the observed topocentric coordinates of the reflection flashes and the direction of the sun. Precise knowledge of the orbital data is not needed, and in many cases no expensive optical instruments are necessary to obtain the information on attitude. For diffuse reflecting cylinders, the formula for the intensity as a function of arbitrary angles of illumination and observation is derived and applied to numerical computations of a tumbling cylinder. Author

N63-23707 Hughes Aircraft Co., Culver City, Calif.
A SELECTED BIBLIOGRAPHY ON SOVIET SATELLITE OPERATIONS 1957-1962
H. Matsumiya, comp. Feb. 1963 6 p 46 refs
(LS-BIB-63-1)

N63-23821 National Aeronautics and Space Administration, Washington, D.C.
NASA TO LAUNCH INTERPLANETARY EXPLORER SATELLITE
Nov. 10, 1963 27 p
Available from NASA. Office of Scientific and Technical Information, Wash., D.C.

The first of a series of seven Interplanetary Monitoring Platform (IMP) satellites is to be launched. It has been designated the Interplanetary Explorer (IMP A) Satellite. Essentially a compact, satellite-borne physics laboratory, IMP's mission is to measure magnetic fields, cosmic rays, and solar winds in interplanetary space—the region beyond the influence of the earth's magnetic field. A highly eccentric orbit is planned, and, at apogee, the IMP A will fly almost three-quarters of the distance to the moon. This orbit is expected to reveal valuable information on the composition and depth of the back of the magnetosphere. J.E.T.

33 STRESSES AND LOADS

Includes: fatigue; vibration; flutter; and structural tests.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 34 Structural Design.

N63-23130 General Dynamics/Astronautics, San Diego, Calif.
ANALYSIS OF CONICAL SHELLS UNDER UNSYMMETRICAL CONDITIONS
J. E. Goldberg Nov. 15, 1961 20 p
(ERR-AN-080)

The differential equations for determining the stresses and displacements in thin, conical shells under unsymmetrical loads are presented. The equations are in a form which is especially convenient for numerical integration on a digital computer. The usual assumptions of classical shell theory are employed. The thickness and mechanical properties of the shell may vary along the generator, but should not vary in the circumferential direction. Certain cases of thermal and dynamic loading are included in the analysis. Author

N63-23133 Columbia U., New York, N.Y.
LONGITUDINAL IMPACT OF A SEMI-INFINITE CIRCULAR VISCOELASTIC ROD Technical Report No. 17
R. B. Testa Sept. 1963 26 p 9 refs
(Contract Nonr-266(34))
(CU-3-63-ONR-266(34)-CE)

The response to longitudinal impact of a semi-infinite, viscoelastic rod of finite radius is investigated. Laplace Transform methods with asymptotic analysis are applied, and use is made of the available results for the equivalent problem of a cylindrical shell. The oscillatory character of the response in the elastic rod is suppressed due to the presence of viscosity. Author

N63-23150 Army Missile Command, Huntsville, Ala.
ON THE PROBLEM OF THE THEORY OF ELASTICITY FOR A REGION CONTAINING MORE THAN TWO SPHERICAL CAVITIES (FIRST AND SECOND REPORTS)
Hiroshi Miyamoto Sept. 13, 1963 23 p 14 refs Transl. into ENGLISH from Japan. Soc. of Mech. Engrs. Trans. (Pt. I), v. 23, no. 131, July 1957 p 431–436
(RSIC-69)

The solution of the problem is based upon the Boussinesq stress-function approach, and a series solution is obtained for the problem of elasticity for a region containing more than two spherical cavities whose centers lie on a line. Numerical evaluations are given for stress distribution along the boundary of cavities when the elastic body is under uniform tension in the direction of the center line. Author

N63-23211 Lockheed-California Co., Burbank
NEW FABRICATION TECHNIQUES FOR SPACE STRUCTURES
M. Childers, R. Liddell, K. Sparling, and R. Titus (Lockheed Missiles and Space Co.) *In* AIAA 2nd Manned Space Flight Meeting [1963] p 67–80 refs (See N63-23201 24-01)

Techniques for the construction of lightweight structures from very thin gage superalloy and refractory materials and from nonmetallic materials, which are folded for launching, expanded in space, and rigidized, are discussed. The techniques employed for superalloys, such as René 41, in gages down to 0.003 inch are well developed and, with a nominal amount of additional work for improvement, structures can be fabricated from these materials. The fabrication of honeycomb panels from 0.001-inch-thick molybdenum is currently in progress. The rigidization of expandable structures is in the early developmental stage. One method which shows considerable promise is the impregnation of the wall material with a suitable resin. After deployment in space, the partially cured resin will then rigidize as the result of the space environment. I.v.L.

N63-23349 North Carolina State Coll., Raleigh School of Physical Sciences and Applied Mathematics
AN EXTERNAL CRACK PROBLEM WITH ASYMMETRICAL LOADING
Morton Lowengrub Sept. 20, 1963 11 p 6 refs
(Contract AF-AFOSR-444-63)

The problem of determining the distribution of stress in an infinite elastic solid containing an external crack which is opened by the application of an asymmetrical pressure is considered. Muki has extended a method of analysis developed by Harding and Sneddon using Hankel transforms to reduce axially-symmetric problems in three-dimensional elasticity to asymmetrical problems. The results obtained in Muki's paper are used. It is assumed that the equations of the classical theory of elasticity hold. Expressions for the stress and displacement components are given. The appropriate boundary-value problem is discussed, and the special case in which the prescribed stress is given as a point of force is considered. R.T.K.

N63-23361 Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
PREPARATION AND PROPERTIES OF FIBER-REINFORCED STRUCTURAL MATERIALS
D. E. Price and H. J. Wagner Aug. 22, 1963 25 p refs
(DMIC Memo. 176)

Metallic fibers in the form of whiskers, chopped fine wire, or wool have been incorporated into metallic matrices by two principal methods: classical powder-metallurgical methods, and infiltration of the fibers with molten matrix metal. Ceramic fibers, notably α-Al_2O_3, have been used as whiskers or wool for reinforcing metallic matrices, the methods of preparation of the composite being the same as with metallic fibers. When metallic fibers are used to reinforce ceramics, the ceramic is either slip cast into the fiber mat and dried, or a mixture of the fiber and ceramic is hot pressed. Plastics and elastomers are combined with fibers by several methods, for example, dipping a sintered skeleton of the fibers into liquid Teflon. Author

N63-23428 Polytechnic Inst. of Brooklyn, N.Y.
CREEP DEFORMATIONS IN MEMBRANE SHELLS
F. A. Cozzarelli and Sharad A. Patel Oct. 1963 28 p 8 refs
(Grant AF-AFOSR-419-63)
(PIBAL-672)

Creep deflections in membrane shells are analyzed. Governing equations are developed in detail for shells with one infinitely large radius of curvature, and for circumferentially closed shells of revolution. For illustration, solutions are obtained for a circular cone under wind load, a cycloidal vault under uniform dead load, and a hemispherical cap under wind load. Author

N63-23469 Borg-Warner Corp., Kalamazoo, Mich. Ingersoll Kalamazoo Div.
STRESS CORROSION TEST RESULTS
Dennis P. Thomason July 15, 1963 13 p 1 ref
(Contract NORd-15719)
(SPDIR-26, Suppl. 1)

Specimens of two high-strength, high-carbon steels (MBMC #1 steel and Super Tricent steel) were exposed to an industrial atmosphere in an effort to determine the effect of surface decarburization on stress-corrosion failures. The specimens were heat treated and tested in the as-heat-treated condition to simulate the actual surface condition of missile castings. It was found that surface decarburization is effective in significantly reducing stress-corrosion failures for the two high-carbon, notch sensitive steels tested. Decarburized MBMC #1 steel exhibited higher resistance to stress and corrosion than did decarburized Super Tricent steel. C.L.W.

N63-23555 General Dynamics/Convair, San Diego, Calif.
PRELIMINARY ANALYSIS OF THE EFFECT OF A DYNAMIC THRUST LOAD ON THE STRUCTURAL INTEGRITY OF THE LITTLE JOE THRUST BULKHEAD
E. C. Kamps July 25, 1963 2 p
(DF-12-111)

Minimum acceptable structural damping factors for the Algol engine (QTV vehicle) for an assumed frequency of 62 cps were calculated. Results are as follows: (1) The minimum acceptable structural factors for a center-mounted Algol engine is $C/C_c = .009$. (2) The minimum acceptable structural damping factors for a periphery mounted Algol engine is $C/C_c = .041$. (This limit is not contingent on multiengine correlation.) From these results, the following conclusions can be made: (1) The single Algol engine QTV vehicle should not experience degradation of thrust bulkhead structure due to a reported $\pm$13,000-pound sinusoidal thrust variation. (2) Any multi-Algol engine vehicle may experience failure of thrust bulkhead structure, i.e., this analysis does not establish improbability of structural failure. I.v.L.

N63-23585 Illinois U., Urbana
THE ENERGY ABSORPTION CAPACITY OF GRANULAR MATERIALS IN ONE-DIMENSIONAL COMPRESSION Final Report
Robert E. Fulton and Bijan Mohraz Kirtland AFB, N. Mex., Res. Directorate, Jan. 1963 199 p refs
(Contract AF 29(601)-4302)
(SWC-TDR-62-91; AFSWC-TDR-62-91)

Energy-absorbing mechanisms in sand subjected to one-dimensional compression are reported. For pressures below crushing of the grains, a granular medium of equal-radii elastic spheres in a face-centered cubic array is analyzed. Expressions are obtained for the axial stress–strain curve, constrained modulus, coefficient of earth pressure at rest, and relationship between absorbed energy and input energy for one cycle of loading. The energy absorbed as a result of crushing is considered by analyzing statistical relationships between changes in grain size distribution curves and the new surface areas created. An apparatus is described which has the capability of maintaining conditions at zero radial strain under increasing axial stress. The lateral stresses developed under these conditions are measured. Author

N63-23628 General Tech. Corp., Torrance, Calif.
COMPUTATIONS FOR STRESS AND STRESS CONCENTRATION IN A CIRCULAR CYLINDRICAL SHELL WITH CIRCULAR CUTOUT Technical Report No. 3-3
S. L. Koh, C. C. Thiel and A. C. Eringen Apr. 1963 195 p
(Contract NObs-78866)

The analytical results cited in Technical Report 3-2 are used in the detailed calculations undertaken for the present report. Three particular cases of cylindrical shells were studied: Case I—a uniformly distributed bending moment around the edge of the cutout; Case II—a uniform longitudinal tensile load with the edge of the cutout stress-free; and Case III—a uniform internal pressure with a uniform transverse shear at the edge of the cutout. The state of stress for each of these three cases is determined for a variety of cylindrical shells having different material and geometry properties. Stress concentration factors are also calculated for Cases I and II. Extensive data have been acquired for these three cases of cylindrical shells with circular cutouts for a variety of material–geometry specifications. Other significant cases may be solved with the use of these data by the simple method of superposition. For example, if the results for Cases I and II are superposed, data are obtained for the important case of a pressure vessel of radius R capped on its lateral side by a membrane cylinder of radius ρ_0. I.v.L.

N63-23687 General Tech. Corp., Torrance, Calif.
STRESS ANALYSIS OF A CIRCULAR CYLINDRICAL SHELL WITH CIRCULAR CUTOUT
A. K. Naghdi and A. C. Eringen Jan. 1963 58 p 6 refs
(Contract NObs-78866)
(Tech. Rept. 3-2)

A class of problems concerned with the determination of the stress field in a circular cylindrical shell with a circular cutout is investigated. Specifically, the following three cases are treated: (1) the shell subjected to a uniformly distributed bending moment around the cutout; (2) the shell subjected to a uniform, axial tensile load with a stress-free cutout; and (3) an internally pressurized shell with a uniform transverse shear at the edge of the cutout. The method employs the exact solution of the Donnell theory of thin shells satisfying the boundary conditions at the circular cutout in a collection sense. Author

N63-23697 Aberdeen Proving Ground, Md. Ballistic Research Labs.
STRESS RELAXATION DEVICE
John M. Hurban Aug. 1963 45 p 7 refs
(BRL-MEMO-1498)

An apparatus has been developed to measure the relaxation modulus in shear of viscoelastic materials. The relaxation device consists of a specimen, gage, and actuating device. The actuating mechanism consists of a tapered beam, a catch, and a device for arresting the rebound. When the catch is released, the beam attains its maximum deflection of 0.1 inch in less than a millisecond. The transient vibrations attenuate to zero in approximately 20 milliseconds, after which the relaxation function G(t) can be measured with a precision of 5%. Author

N63-23745 Aeronautical Research Council (Gt. Brit.)
ON THE EXTRAPOLATION AND SCATTER OF CREEP DATA
K. F. A. Walles and A. Graham 1963 41 p refs
(ARC-CP-680; replaces NGTE-R-247; ARC-23518)
Available from HMSO: 7s 6d

A method of extrapolation based on a previously given formula for creep is derived, and examples are given of its application to creep rupture and creep strain data. The accuracy of extrapolation is statistically evaluated and shown to be within the observed scatter of the experimental data. Seven other methods are shown to have errors significantly greater than that of the data. Limitations of the method are discussed. Author

N63-23753 Mechanical Technology, Inc., Latham, N.Y.
VISCOUS SHEAR COMPRESSOR
E. B. Arwas and B. Sternlicht Sept. 1962 27 p
(Contract Nonr 3730(00))
(MTI-62TR21)

The analysis presented here considers a grooved-plate viscous shear compressor under polytropic flow conditions. Several special cases are treated, e.g., incompressible flow, compressible flow with adiabatic and isothermal compression. Dimensionless curves for calculation of pressure rise as a function of flow are given for (1) isothermal compression, (2) adiabatic compression, monatomic gas, and (3) adiabatic compression, diatomic gas. Sample results are given in graphical form for a specific size compressor operating at 24,000 rpm with four different film thicknesses, ambient pressure and temperature under isothermal and adiabatic conditions, with air and helium gases. Author

34 STRUCTURAL DESIGN

Includes: structural elements; and weight analysis.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 33 Stresses and Loads.

N63-23126 National Aeronautics and Space Administration, Washington, D.C.
RECOMMENDATIONS AND EVALUATIONS OF MATERIALS-RESEARCH AREAS OF IMPORTANCE TO MISSILE AND SPACE VEHICLE STRUCTURES
Jack B. Esgar, Norris F. Dow, and William R. Micks Oct. 1963 31 p 8 refs Prepared in collaboration with the NASA Res. Advisory Comm. on Missile and Space Vehicle Struct.
(NASA TN D-2125) OTS: $0.75

Several requirements for research on new and improved structural materials are reviewed and discussed. Information about these requirements in terms of the description of the applications and advantages for improved materials is reviewed for high-temperature materials with oxidation resistance and ductility, low-temperature materials with ductility and impermeability, pressure vessel materials, and shielding materials. Author

N63-23646 Rensselaer Polytechnic Inst., Troy, N.Y.
NORMAL MODE VIBRATIONS OF SYSTEMS OF ELASTICALLY CONNECTED PARALLEL BEAMS
J. M. Seelig and W. H. Hoppmann II July 1963 27 p refs
(Contract DA-30-069-AMC-195(R))

The report presents the development and solution of the differential equations of motion of a system of n-elastically-connected parallel beams. Using the results developed for the general n-beam system, the particular case of a two-beam system was analyzed in detail. The frequencies and associated mode shapes for various support conditions are presented explicitly. Vibration experiments were performed in order to ascertain the degree of applicability of the theory. It was found that at least up to the eighth mode, reasonably good agreement obtains. Author

N63-23820 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
PARTIAL MATHEMATICAL SOLUTION OF THE THREE-DIMENSIONAL FOUR-BAR LINKAGE
R.G.Chamberlain Sept. 16, 1963 18p refs
(NASA Contract NAS7-100)
(NASA CR-52249; JPL-TR-32-386) OTS: $1.60 ph, $0.80 mf

This paper considers a four-bar linkage of which two adjacent hinges have skew axes and are fixed in the coordinate system. The remaining two joints are universal. Analytical relations are found between the rotations, angular velocities, angular accelerations, and torques about the fixed joints. Author

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